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EPOCH-MAKING BOOKS IN BRITISH SURGERY.

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XII. SIR ASTLEY COOPER'S "TREATISE ON DISLOCATIONS AND FRACTURES."

SIR ASTLEY COOPER'S *Treatise on Dislocations and Fractures of the Joints* was the English classic until the American surgeons introduced manipulation in place of pulleys and until the whole subject was revolutionized first by the discovery of X rays and afterwards by the enormous experience gained during the European War.

The book, a large quarto illustrated with thirty plates, first appeared in 1822, and is dedicated in a graceful preface to the students of St. Thomas's and Guy's Hospitals. It ran through ten editions and was published at the price of £1 11s. 6d. It is still worth reading, partly for the detailed account of the cases it contains, and partly because it recalls the difficulties which surgeons experienced at a time when anæsthesia was unknown.

The routine preliminary treatment in cases of dislocation of the hip is described in the following words :—

" In the reduction of this dislocation, the following plan is to be adopted ; take from the patient twelve to twenty ounces of blood, or even more if he be a very strong man ; and then place him in a warm bath at the heat of 100° and gradually increase it to 110° until he feels faint. During the time he is in the warm bath give him a grain of tartarized antimony every ten minutes until he feels some nausea, then remove him from the bath and put him in blankets and place him between two strong posts about ten feet asunder in which two staples are fixed ; or rings may be screwed into the floor and the patient be placed upon it. My usual method is to place him upon a table covered with a thick blanket, upon his back ; then a strong girth is passed between his pudendum and thigh and this is fixed to one of the staples. A wetted linen roller is to be tightly applied just above the knee and upon this a leather strap is buckled having two straps with rings at right angles with the circular part. The knee is to be slightly bent but

not quite to a right angle and brought across the other thigh a little above the knee of that limb. The pulleys are fixed to the other staple and in the straps above the knee. The patient being thus adjusted the surgeon slightly draws the string of the pulley and when he sees that every part of the bandage is upon the stretch and the patient begins to complain, he waits a little to give the muscles time to fatigue; he then draws again and when the patient complains much, again rests until the muscles yield. Thus he gradually proceeds until he finds the head of the bone approach the acetabulum. When it reaches the lip of the cavity, he gives the pulley to an assistant and desires him to preserve the same state of extension and the surgeon then rotates the knee and foot gently, but not with a violence to excite opposition in the muscles, and in this act the bone slips into place."

What a difference to the simple instruction for reduction after the introduction of anæsthesia—"Put the patient on his back; flex the leg on the thigh, the thigh on the abdomen; abduct; rotate outwards"!

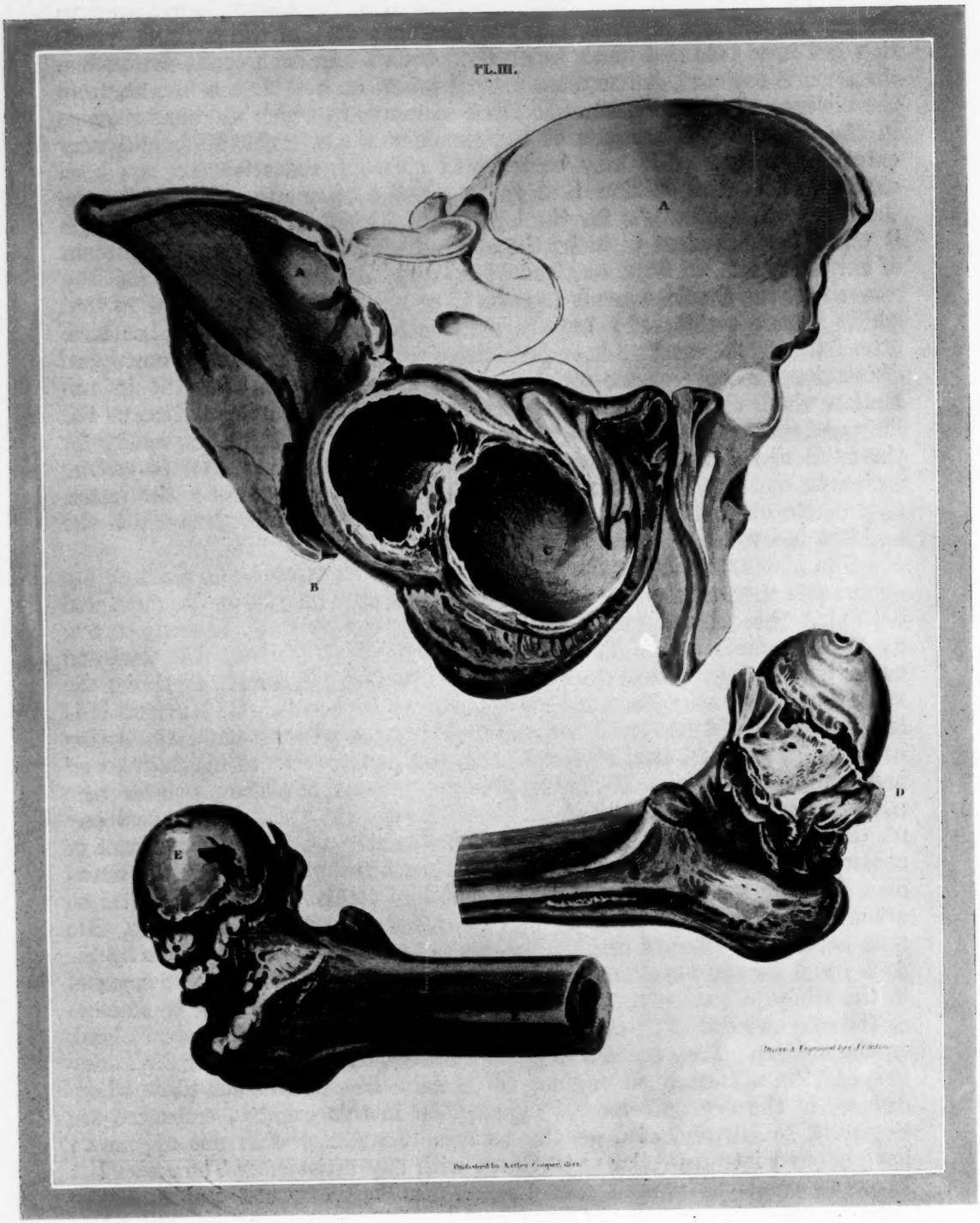
In dislocation of the shoulder Sir Astley recommends reduction by the heel or knee in the axilla, the patient having been previously bled and put into a warm bath at a temperature of 100° or 110°, a grain of tartrate of antimony being given every ten minutes until he becomes faint. "He is wrapped in a blanket, placed in a chair, and extension made before the muscles have time to recover. The scapula is fixed by means of a bandage which allows the arm to pass through it, a wetted roller is next to be bound around the upper arm just above the elbow, and upon this a very strong worsted tape is to be fastened. The arm should then be raised at right angles with the body, or a little higher if there be much difficulty of reduction; two persons should draw the bandage affixed to the arm, and two from the scapula bandage with a steady, equal and combined force. Jerking should be entirely avoided and every quick reduction discountenanced. "*Slowly and Steadily*" should be the word of command from the surgeon, who after the extension has been made for some minutes should place his knee in the axilla, resting his foot upon the chair; he then raises his knee by extending his foot; and placing his right hand upon the acromion pushes it downwards and inwards, when the bone usually slips into its natural position. A gentle rotatory motion during the extension is sometimes productive of diminished opposition in the muscles. These means failing we must have recourse to the pulleys—not with a view of employing *greater* force for that could be obtained by more persons; but with the view of applying *gradual and equal* force without jerks and unequal extension which are sure to occur when manual strength is employed for any length of time."

If Astley Cooper was hampered in his methods partly by tradition but chiefly by the vitality of his patients, he has the credit of putting the etiology of dislocations and fractures upon a sound anatomical basis. He draws attention to the importance of a knowledge of the ligaments in connection with dislocation, but, dealing only with conscious patients, he attributes the difficulty of reduction almost wholly to muscular contraction. His teaching in regard to dislocations of long standing was emphatic, for he says:—

"I believe that much mischief is produced by attempts to reduce dislocations of long duration in very muscular persons. I have seen great contusion

of the integuments, laceration and bruising of the muscles, tension of nerves inducing an insensibility and paralysis of the hand, occasioned by an abortive attempt to reduce a dislocation of the shoulder; so that the patient's condition has been rendered much worse than before. In such cases, even when the bone is replaced, it has often proved rather an evil than a benefit, from the violence of the extension. In those instances in which the bone remains in the axilla, in dislocations of the shoulder a serviceable limb and very extensive motions of it may be regained although reduction has not been effected. I am of opinion that three months after the accident for the shoulder and eight weeks for the hip, may be fixed as the period at which it would be imprudent to make the attempt at reduction, except in persons of extremely relaxed fibre, or of advanced age. At the same time I am fully aware that the shoulder has been reduced at a more distant period than that which I have mentioned; but, in most instances, the reduction has been attended with the results I have just been deprecating. In cases of unreduced dislocation the only course which the surgeon can adopt, after the inflammation which the injury produces has subsided, is to advise motion of the limb and friction of the injured part—the former to produce a new cavity for the head of the bone to assist in forming a new ligament and to restore action to muscles, which they would otherwise lose by repose; the latter, to promote absorption and to remove the swelling and adhesions which the accident has caused."

The plates illustrating the different forms of dislocation and fracture are remarkable specimens of the art of the time, as may be seen in the appended example. The majority were drawn and engraved by C. J. Canton; a few by H. Thompson, and I. T. Wedgwood; some by J. Basire. The unsigned engravings may have been drawn by T. Kirtland who had done much artistic work for Cooper when he published his treatise on hernia. Of Kirtland it is known that he fell into bad ways, could never work without some stimulating beverage at his side, became irregular in the performance of his duties, and had to be discharged. H. Thompson was a poor miniature painter who possessed considerable talent as a draughtsman. He had never studied any of the higher branches of art and consequently was wholly ignorant of anatomy. This was found to be an impediment to him in making the drawings, and Sir Astley Cooper therefore sent him to St. Thomas's Hospital to attend the lectures on anatomy and to engage in practical dissecting. He thus became an efficient artist. He was retained three days a week by Sir Astley and for the remaining three days by Dr. Farre, who was also engaged in the study of anatomy. Thompson afterwards devoted himself to diseases of the eye and did some delicate coloured drawings for Mr. Saunders's book on the subject. They are not so good, however, as those done for Sir Astley Cooper. He ultimately determined to establish himself in some place where diseases of the eye were more frequent than in this country, embarked for the West Indies, and died on the voyage. Sir Astley does not appear to have entered into a regular engagement with any artist after Thompson left him, but employed various draughtsmen like T. Wedgwood and J. Basire until he found C. J. Canton, who proved to be so good that he engaged him permanently after he left Broad Street in the late autumn of 1815 in the


PL. III.
A
B
C
D
E

hope of diminishing his practice, which was already too great for his strength.

The illustration is from a preparation in the Museum of St. Thomas's Hospital. It "shows", says Sir Astley, "a dislocation into the foramen ovale which had never been reduced and beautifully exhibits the resources of nature, in forming a new socket for the head of the bone and allowing of the restoration of a considerable degree of motion". The relative situation and appearance of the new and original acetabulum are well seen. A, A are the ilia; B is the original acetabulum little more than half its natural size, the edge of the new acetabulum occupying its lower and anterior part; C is the new acetabulum formed in the foramen ovale, a deep ossific edge surrounding it; its internal surface is extremely smooth; the ligament of the foramen ovale has disappeared and ossific matter has been deposited in its stead; D is the thigh bone removed, and the portion of the new acetabulum is shown which was obliged to be broken off to separate the thigh bone from its new socket; E is the head and neck of the thigh bone, the former a little changed by absorption and the latter by ossific deposit.

It does not seem possible now to trace all the ten editions of the book. The first was issued in 1822, the second in 1823, the fifth in 1826, the sixth in 1829, and the tenth in 1839. The octavo edition which was edited by Bransby B. Cooper appeared in 1842.

COMMON-DUCT STONES OF LIVER ORIGIN.

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Disease amongst the Chinese follows much the same lines as disease amongst Europeans; but there are a number of striking differences. The object of this paper is to draw attention to one of these differences which, so far as I am aware, has not hitherto been described. There is no mention of it in the recently published second edition of Jeffreys and Maxwell's *Diseases of China*.

Fig. 353.—Slices of liver showing intrahepatic stone formation. From a museum specimen. The patient was a Chinese. No clinical history obtainable. (× ⅔.)

When we find a stone in the common bile-duct in a European or American woman it is nearly always of small or moderate size, and we are sure that it originated in the gall-bladder. Large stones in the gall-bladder may ulcerate into the duodenum or transverse colon. Smaller stones may pass along the cystic duct, or occasionally ulcerate into the common duct. Before doing so they have remained in the gall-bladder so long and damaged it to such an extent that this organ has become cicatricially contracted. Hence the well-known generalization of Courvoisier that a distended gall-bladder associated with chronic jaundice is not due to gall-stones. As the gall-bladder is diseased it should always be removed.

In Chinese patients as seen in Hong-Kong we find an entirely different picture. Stones in the common duct usually originate in the liver (*Fig.* 353). When they reach the common duct they grow to a remarkable size (*see Figs.* 356, 358) and lead to distension of the gall-bladder (*Fig.* 354), thus breaking Courvoisier's law. They produce a striking and unmistakable syndrome. Excision of the gall-bladder appears to be contra-indicated.

Though this is the general rule, gall-stones do very occasionally form in the Hong-Kong Chinese gall-bladder, but in my own practice I have operated on many more gall-bladder stones in Europeans than in Chinese, though Europeans number perhaps eleven thousand in Hong-Kong, whilst the natives total almost six hundred and twenty thousand. In addition, Chinese patients from the interior come to Hong-Kong for treatment. Conversely, intrahepatic stone formation occurs as a rarity amongst Europeans. The frequency of its occurrence amongst Chinese in Hong-Kong facilitates the

study of the condition and may perhaps enable some light to be thrown on the relatively uncommon cases in Europe.

It must, however, be confessed that this paper merely opens the subject. One has seen and heard of a large number of cases which one feels confident represent this disorder. I used not at one time to recognize the condition. Some later cases have refused operation; one or two were moribund when first seen. My old friend Dr. G. H. Thomas has seen the affection both at successful operations and at post-mortem examinations, but his notes and specimens (with one exception) were unfortunately thrown away. He first performed an operation for this condition in 1919. This is the earliest case of which I have heard. These cases have regretfully been excluded and I have confined this study to ten cases, seven fully and one partly reported, and all with the diagnosis proved at operation or at post-mortem. Two of the illustrations come from specimens in the museum; they were from mortuary cases where no clinical history was forthcoming. The death-rate is too high, even for this serious class of case, and it seems that one is only now feeling the way to a correct line of treatment.

Fig. 354.—Portion of liver with distended gall-bladder, cystic, and common ducts. A large stone is seen projecting from the common bile-duct where cut across. From a museum specimen. The patient was a Chinese. No clinical history obtainable. (× ⅔.)

Etiology.—The sufferers from the condition here reported were all adults (ages 34, 38, 35, 28, 22, 42, 'middle-aged', and 42 years). Four were males, four females. One of these patients was very fat; all the others were spare, and *Case* 2 was very thin. All eight were of the poorer class, but I have seen what appears to be the same condition in well-to-do Chinese. With regard to alcohol, there is no record in *Cases* 1–5 or in *Case* 7. *Case* 6 neither drank nor smoked. *Case* 8 smoked tobacco, but only took small quantities of wine occasionally. *Case* 2 was an opium smoker and had been sent to prison for keeping an opium divan. None of the patients gave a history of previous illness of any apparent importance.

Morbid Anatomy.—In all these cases there was great enlargement of the common bile and the common hepatic ducts, up to a diameter of one inch (*Case* 6). In every case the gall-bladder was much distended (*Fig.* 354)

and the liver was enlarged. In the post-mortem cases the intrahepatic ducts showed dilatation when the liver was cut across. Adhesions between the liver and great omentum were noted in *Case* 6, and between the liver and diaphragm in *Case* 7. The gall-bladder was recorded as showing adhesions in *Case* 6. In *Cases* 1 and 2 the gall-bladder and the bile-ducts contained mucus untinged by bile, signifying that complete suppression of bile had supervened. No stones were found in the gall-bladder of any of these cases, but a little muddy débris was seen in *Case* 1.

In all eight cases, however, stones were found in the common ducts. These appeared to be either very numerous and only moderately large (*Cases* 1, 2, 5, 8), or few in number, one or more, and enormous in size (*Cases* 3, 4, 6, 7—*see Figs.* 356, 358). These common-duct stones, though definite in shape and often faceted (*see Fig.* 356), were soft enough to be crushed between finger and thumb. When dried the outer laminæ tended to flake off in patches (*see Fig.* 358B). They appeared to consist chiefly of bile pigments. Dr. S. Y. Wong of the Department of Physiology kindly examined parts of the stone removed after death from *Case* 7 (*see Fig.* 358B). The results of the analysis were :—

Bilirubin	67·30
Biliverdin	25·82
Cholesterol	1·64
Calcium	1·20
Phosphate	2·10
Iron	trace
Copper	trace (?)

Smaller stones were found in the intrahepatic ducts at operation in *Cases* 1, 2, 5, and 8. *Fig.* 353 shows the appearance of intrahepatic stones from the post-mortem examination of a patient where no clinical history was obtainable. Such intrahepatic stone formation has been observed by Dr. G. H. Thomas and by myself at other times in the Public Mortuary. The kidneys showed some nephritis.

Pathology.—Infestation of the liver by liver flukes (*Clonorchis sinensis*) is not uncommon in Hong-Kong. I operated on one case of colic due to blockage of the cystic duct by these parasites, and for several days flukes continued to escape in the bile from the fistula. Flukes are not infrequently seen in the liver in post-mortem examinations, and the ova were seen in 21 per cent of 512 cases examined in our medical wards by Dr. Mustapha Bin Osman. They have also been found in association with hypertrophic cirrhosis.

Both cirrhosis of the liver and malignant disease of the liver are commoner in South China than in Europe, and the liver fluke has been put forward as a possible explanation. It is natural, then, to suggest that the liver fluke may have something to do with intrahepatic stone formation also; but our cases give no support to this idea. No flukes were found in our three fatal cases, and repeated examinations for the ova in the fæces were unsuccessful in two others (*Cases* 5 and 6). A single examination of the bile was also unsuccessful in *Case* 1.

Some chemical food poison might conceivably lead to inspissation of the bile and stone formation; but a more probable view is that acute cholangitis due to some bacterial infection originates the disease. The rigors and fever

certainly show that acute cholangitis was present in our patients when they came under observation. In *Cases* 6 and 8 it was noticed that the bile had a most unpleasant mawkish odour. Direct bacteriological examination of the bile in these cases has not been carried out.

Symptoms and Physical Signs.—Previous attacks of pain in the epigastric and right hypochondriac regions were the rule: in *Case* 1, nine months before; *Case* 3, five months before; *Case* 4, "colic two or three years ago"; *Case* 5, two years ago; *Case* 6, frequent attacks for four years; *Case* 8, four or five attacks during the previous six or seven years. These previous attacks were sometimes accompanied by rigors and jaundice.

The present attack had lasted from onset to operation: in *Case* 1, three days; in *Case* 2, seventeen days; in *Case* 3, twenty-eight days; in *Case* 4, seven days; in *Case* 5, twenty-four days; in *Case* 6, two and a half months; in *Case* 7, ?; in *Case* 8, ten days.

These cases show that there are five cardinal signs or symptoms of this condition. When all five are present the syndrome is so distinctive and so unlike that of other diseases that it may be described as pathognomonic. These five cardinal signs are: (1) Pain in the epigastrium and right hypochondrium; (2) Enlargement of liver (and of gall-bladder); (3) Rigors; (4) Jaundice; (5) Albuminuria. These signs were all present in each of our eight cases with few exceptions. In *Case* 7 details are not given as to rigors or albuminuria. The urine was free from albumin in *Cases* 3 and 4, and in *Cases* 4 and 6 irregular fever is recorded but rigors are not mentioned.

1. *Pain.*—The pain was situated in the epigastrium and right hypochondrium. In *Case* 3 pain was also reported in the back. There was no reference of pain to the angle of the scapula or to the acromion process. Sleeplessness as a result of the pain was present in *Case* 3.

2. *Enlargement of Liver and Gall-bladder.*—The liver was enlarged clinically to two, three, or four finger-breadths below the costal margin. The enlarged liver was noted to be tender in *Cases* 1, 2, and 6. Abdominal rigidity especially pronounced on the right side was recorded in *Cases* 2, 5, and 6.

Enlargement of the gall-bladder was always found at operation or at post-mortem, but was sometimes masked at the bedside by the great enlargement of the liver. Clearly seen in *Cases* 2, 4, and 6, it was suspected in *Cases* 3, 5, and 8. When a gall-bladder enlarges it does so downwards and medialwards towards the umbilicus; but where there is enormous enlargement of the liver as well, the gall-bladder tumour increases directly downwards, and in *Case* 2 presented as a tumour in the right iliac fossa visible through the abdominal wall (*Fig.* 355).

3. *Rigors.*—These were recorded in *Cases* 1, 2, 3, 5, and 8. In *Case* 4 fever only was put down. *Case* 6 showed a typical 'steeple' chart (*see Fig.* 357). Apart from definite rigors, 'chills' were recorded.

A blood-count in *Case* 8 showed a leucocytosis of 20,000 per c.mm. The tongue was coated, and sweating and general weakness were recorded in *Case* 6. Headache was mentioned in *Case* 5, giddiness in *Cases* 1 and 3, and thirst in *Cases* 3 and 8.

4. *Jaundice.*—This was present in all the eight cases, the sclerotics and skin being moderately tinged. Bile pigments were present in the urine as

shown by coloured froth and by a green ring with alcoholic iodine. Skin irritation was noticed only in *Case* 2 and was then described as slight. This was the only case in which pale fæces were recorded, but I believe this sign was present in several others. In *Case* 1 the motions were recorded as 'feeling hot'.

Loss of appetite is remarked upon in *Cases* 1 and 5, and constipation in *Cases* 1, 4, and 5. Vomiting or regurgitations were a feature in *Cases* 3, 4, 6, and 8. In *Case* 3 X-ray examination showed gastric stasis. It may here be said that not much use was made of X-ray examinations, as it was felt that the overlapping liver and the bile-pigment composition of the stones were unfavourable. A special technique should perhaps show the shadow of

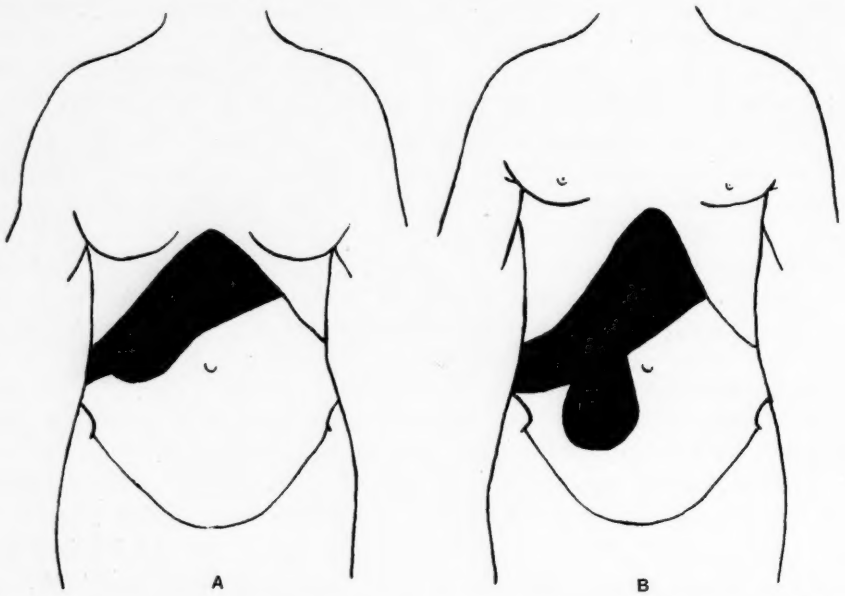

FIG. 355.—A, Diagram of the abdominal tumour usually seen. B, Diagram of the abdominal tumour seen in *Case* 2; both gall-bladder and liver show an unusual degree of enlargement.

the large stones. Graham's tetra-iodo-phenolphthalein gall-bladder concentration test was not tried in this series of cases.

5. *Albuminuria.*—This was the least constant sign of the pentad, being definitely absent in two of the cases. In the others it was present in considerable degree, and casts were found on microscopical examination in *Cases* 6 and 8.

Treatment.—If left alone these cases probably all die from the condition sooner or later. Early operation is therefore indicated; but attacks frequently subside for the time being, and if the general condition is good and the attacks appear to be subsiding, it may be well to wait till jaundice has passed, for reactionary hæmorrhage was a feature in two fatal operation cases. Intramuscular injections of calcium chloride and subcutaneous injections of hæmostatic serum are indicated both before and after operation.

The immediate surgical indication is *choledochostomy with removal of the stones*. The stones causing intermittent obstruction and back-pressure must be taken away; the infected ducts must be freely drained for several weeks.

It is not always possible to remove all the stones. They may stretch up far into the liver. The common hepatic and common bile-ducts are usually large enough in these cases to admit the finger down to the ampulla and up to the bifurcation into right and left hepatic ducts. Stones in the latter may be dislodged with a scoop or by a gentle stream of saline introduced beyond them by a catheter or other tubular instrument. If further small stones are felt far into the liver substance and cannot be dislodged, it would appear to be sound treatment to perform a secondary hepaticodochoduodenostomy (though I have not yet done this operation for intrahepatic stones). Generally the patients are too ill for this to be attempted at the first operation, but where stones have been left behind in the liver this procedure should be considered some six weeks later. The duodenum is retracted downwards by a stay-stitch after the peritoneum along its upper border has been transversely divided. The dilated common bile-duct is freed and divided. The cut distal end is sewn over, whilst the cut proximal end is implanted into the duodenum. Further stones as they come down will pass harmlessly into the alimentary canal. The biliary system will be freely drained. It will of course be no onger protected by a valve, but this does not seem to matter when hepaticodochoduodenostomy has been performed for stricture of the common bile-duct.

A case of mine in which hepaticodochoduodenostomy for stricture was performed is now extremely fit and well nearly five years afterwards—and this is of course the usual experience. The question arises whether the gall-bladder should be removed or drained. As it does not contain calculi and as it serves as a 'safety-valve' reservoir, delaying and often preventing the onset of complete suppression of bile, removal should not be undertaken. Simple drainage is not always called for, though, at the operation, aspiration of a huge gall-bladder may give better access to the deeper parts.

Approach to the common ducts may be obtained by the usual incisions. The one we now prefer is the right paramedian, and two special points are made: (1) The incision reaches just below the umbilicus so that the tendinous inscription from the umbilicus is divided; (2) The rectus muscle is infiltrated with several ounces of 0·2 per cent β-eucaine (benzylamine lactate) till it becomes completely flabby. These two measures obviate the need for division or forcible retraction of the rectus muscle later when the spine is hyperextended in the 'gall-bladder position'. Besides a rubber tube in the common duct for several days, the half of a longitudinally bisected rubber tube is left for twenty-four hours in the right posterior subphrenic pouch.

Mann, of the Mayo Clinic, showed that dogs would survive the two-stage removal of the liver for several weeks if freely supplied with glucose, but would die in forty-eight hours otherwise. Glucose is clearly indicated both as a pre- and post-operative measure for these cases of intrahepatic stone-formation with greatly impaired liver function.

CASE REPORTS.

Case 1.*—**Intrahepatic stone-formation; complete suppression of bile: cholecystostomy and choledochostomy with removal of stones. Recovery.**

Chan How, male, age 34 years, a basket-maker, was admitted to the Civil Hospital on April 21, 1924, with an attack of severe abdominal pain.

History.—There was a history of a previous attack of abdominal pain which took place nine months ago. The pain was of sudden onset, was chiefly noticed in the right hypochondriac region, and lasted for two days, during which period the appetite was poor and the motions were black and soft. The present attack was ushered in by a chill three days before admission. For a whole fortnight, however, there had been constipation—one action of the bowels in about five days. The chill was followed by fever and pain all over the abdomen, especially in the right subcostal region. The patient felt dizzy and his motions were soft and black and felt hot during evacuation. The appetite was bad. The temperature was 101·2°. A moderate degree of jaundice was present and the urine contained both bile and albumin.

On Examination.—An examination of the abdomen showed that a large tumour with a suggestion of lobulation on the surface reached below the costal margin. It was dull to percussion, the dullness being continuous with that of the liver above the costal margin. The lower border of the tumour was thickened and ran obliquely downwards and to the right. It moved slightly on respiration and reached a point just below the umbilicus. The tumour was tender and painful. The greatly enlarged liver with fever would have suggested amœbic abscess; but jaundice is very unusual in such cases. Some calculus obstruction of the common duct seemed more probable.

Operation.—On the day of admission laparotomy was performed through a right paramedian incision. The gall-bladder was found to be distended, and on incision clear glycerin-like fluid with a little black débris escaped. Cholecystostomy was performed. On further examination a large stone was felt projecting from within the liver into one of the hepatic ducts. This lay at a great depth; it was cut down upon, and removed with difficulty as it was tightly impacted. A further large calculus which was slightly movable was removed from deeply within the liver. Clear glycerin-like 'white bile' escaped from the ducts. Further stones could be felt within the liver, but could not be extracted. A second large rubber tube was inserted into the duct. The laparotomy wound was closed in the usual way. Coloured bile was discovered passing from both tubes by the following morning. The patient was treated after operation with injections of calcium chloride and with rectal glucose and with hypodermic injections of morphia.

On April 26, the patient was again carried to the operation theatre, but no anæsthetic was administered. A long spoon was inserted along the track of the drainage tube into the hepatic ducts and at least a dozen small calculi were removed from the bile-ducts in the liver. They were of solid black matter, oval in shape, and about the size of peas. Some of the discharging bile was examined for *Clonorchis* ova on one occasion, but none were found.

The patient was discharged on May 17; the wound was healed; the fæces were normal in colour; there was no jaundice, and the temperature had been normal since the fourth day after operation.

Case 2.*—**Intrahepatic stone-formation; complete suppression of bile; partial cholecystectomy and choledochostomy with removal of stones; reactionary hæmorrhage. Death on the tenth day.**

Ho Shan, male, age 38 years, committed to prison on a charge of keeping an opium divan, himself an opium smoker. Routine examination by the Prison Medical Officer showed signs of jaundice, and he was transferred to the Government Civil Hospital on May 22, 1924.

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* Previously reported in collaboration with Dr. A. G. M. Severn in the *Caduceus*, 1924, Oct., 145.

History.—No previous history of attacks of acute abdominal pain or other serious illness was elicited. The patient had noticed the jaundice gradually coming on for some few weeks, but had not regarded it as anything serious.

On Admission.—On entering the Civil Hospital the general condition was not good, the patient being rather thin and poorly nourished; temperature 99·4°. He complained of some abdominal pain. There was a moderate degree of jaundice, yellow sclerotics, and slight skin irritation. Tenderness and rigidity over the gall-bladder area was present and the liver dullness extended below the costal margin. No other abdominal signs were noted and the gall-bladder was said then to be not definitely palpable (?). The urine contained bile pigment, bile salts, and a trace of albumin; the fæces were rather pale, but not clay-like.

On the day following admission the patient had a rigor, but the temperature did not rise above 101·1°. During the subsequent fortnight the temperature approached normal, generally varying between 98° and 99°. The patient was kept under observation and on light diet and fluids; the jaundice remained about the same; the bowels were regular. Tenderness in the right hypochondrium persisted, with slight rigidity, but without much pain. Salines with ipecacuanha wine and sodium salicylate were given four-hourly. On the seventeenth day the patient had a severe attack of acute abdominal pain, temperature 99°, for which morphia was given. On the following day the temperature rose to 101°. There was marked tenderness and rigidity over the liver area and right hypochondrium. A large mass, dull on percussion, extended down to the right iliac region, producing a tumour readily visible on respiration. The mass was diagnosed as a greatly enlarged gall-bladder (*see Fig.* 355B).

Operation.—The patient was given intramuscular injections of calcium chloride gr. ij, three doses at suitable intervals, in preparation for operation. Hypodermic injections of morphia and atropine preceded the anæsthetic, which consisted of ether only, by the closed method. On June 8 an operation was performed which consisted in an exploratory laparotomy, partial cholecystectomy, and choledochotomy. Hæmorrhage from the small vessels was profuse. The free incision disclosed an enormously distended liver—making approach to the bile-ducts extremely difficult—and a very large, tense, and distended gall-bladder, containing a quantity of 'white bile' which had the appearance and consistency of slightly diluted glycerin, together with a considerable residue of dark-coloured granular débris. An incision was then made into the bile-duct above the cystic duct and close to the liver. Masses of soft friable gall-stones, partially faceted, blocked the bile and hepatic ducts, and extended through the branches of the hepatic duct deep into the liver substance. A number of large gall-stones and fragments were extracted, as far up as three inches into the liver, so that the jam seemed relieved and the remaining stones were freely movable. Their complete removal was a matter of impossibility. The common bile-duct, as far as its junction with the duodenum, appeared to be patent and unobstructed. The fundus of the gall-bladder, having been pulled forward by a clamp to give better access to the bile-duct, was amputated, and a medium-sized rubber drainage tube sutured to the stump. The distended bile-duct was drained with a half-inch diameter tube and a third smaller drainage tube was inserted into the right posterior subphrenic pouch. The poor physical condition of the patient did not admit of a more extensive operation. Normal green bile, in small quantity, commenced to flow, via the drainage tubes, within a few hours of the operation, together with granular débris and small fragments of gall-stones.

After-treatment consisted of normal saline, water, and solution of sodium bicarbonate, in quantities of half a pint, given rectally two-hourly in succession for the first day, and afterwards four-hourly. An attempt was made to obtain glucose for rectal administration, but unfortunately there was none available at the moment in the Colony. Nothing was given for the first twenty-four hours; afterwards fluids at short intervals and in increasing quantities. On the day following the operation the patient had persistent vomiting, which was relieved by a suitable carminative mixture. Tincture of opium in small doses was regularly given, in view of the patient's opium habit. The temperature ranged between 101° and 103°.

Three days after the operation some blood-clot was passed via the drainage tubes, and the bile which escaped was intimately mixed with blood. This continued in spite of hypodermic injections of morphia and intramuscular injections of calcium chloride. The general condition was fair, and the temperature gradually decreased, but the jaundice persisted, a slight improvement only being noticeable in this respect. The temperature remained about 100°, and there were no signs of general peritonitis. After removal of the drainage tubes, a good deal of blood-clot was discharged through the abdominal wound, together with blood-stained bile. The patient became progressively weaker, and death took place on the tenth day after the operation, i.e., on June 18, 1924.

Post-mortem Examination.—Autopsy showed some enlargement of the liver, which was pale and mottled in appearance. Masses of friable stones blocked the main hepatic ducts and extended into the smaller branches, so that the liver appeared to be full of these soft stones. Specimens of them were sent to the analyst for chemical examination. Two separate portions of the liver substance and a piece of the kidney were sent to the pathologist for section. Unfortunately in a considerable rush of work at the time, these were mislaid. A mass of blood-clot was found in the remains of the gall-bladder and in the peritoneal cavity on the right side, extending as far as the right iliac fossa. The common bile-duct was not obstructed, and its opening into the duodenum was normal in appearance. The kidneys were rather pale and slightly enlarged, the capsule separated readily. There were signs of local inflammation of the peritoneum, but no evidence of general peritonitis. The brain and meninges were normal in appearance, as were also the heart, lungs, spleen, pancreas, and alimentary tract.

Case 3.—**Two large common-duct stones of liver origin: choledochostomy with removal of stones. Recovery.**

Li Tang (Case No. 496/26), female, age 35 years, housewife, was admitted on Dec. 21, 1926, for pain in the upper part of the abdomen and in the back.

History.—The patient was a married woman with three healthy children. She had always enjoyed good health till five months before, when she had an attack of pain over the right hypochondrium. She went to see a doctor, who gave her one injection, and the pain was then relieved. Two weeks later pain began over the back and then extended to both hypochondriac regions and the epigastrium. Injections gave her temporary relief, but one week later the pain recurred. The pain was accompanied by vomiting and a feeling of chillness in both hands and feet. Sleeping was also disturbed by the pain. Sometimes one or two hours after one of the injections there was giddiness, and the patient felt thirsty for two or three hours.

On Admission.—When admitted the patient showed no fever, but she complained of pain over the back and slightly over the epigastrium. She was wasted and slightly jaundiced, showing tinting of the conjunctivæ. Bile was present in the urine, but albumin was not found in this case. The blood-pressure was low: systolic 70 mm. and diastolic 40 mm. X-ray examinations showed delayed emptying of the stomach, "a moderate gastric residuum being present after six hours". I have a distinct recollection that the liver and gall-bladder were clinically enlarged, but there is no note in the report to this effect.

Operation.—After two intramuscular injections of calcium chloride (gr. ij each) on Dec. 28 and 29, the patient was subjected to operation, under open warm ether, during which two pints of normal saline were given intravenously. The abdomen was opened by a right paramedian incision. The first part of the duodenum was displaced downwards with a stay stitch and the peritoneum transversely incised along its upper border. A greatly enlarged common bile-duct was thus exposed, and opened by a vertical incision over an inch in length. Bile flowed out, and two gall-stones were removed, which when placed with their flat surfaces together resembled an egg measuring $1\frac{1}{2}$ by $2\frac{1}{2}$ in. (*Fig.* 356). The enormously enlarged duct was explored upwards and downwards with the finger, but no other stones were found. A large rubber tube was introduced into the common duct and lightly secured by a plain catgut purse-string suture.

After operation digitalin injections were given, and glucose (3 per cent) and sodium bicarbonate (1 per cent) were administered per rectum, 6 pints in the twenty-four hours. The rubber tube was removed three days after the operation.

The patient was discharged on Feb. 7, the wound being completely healed. No more pain had been felt in the back or epigastrium, and there had been no more jaundice.

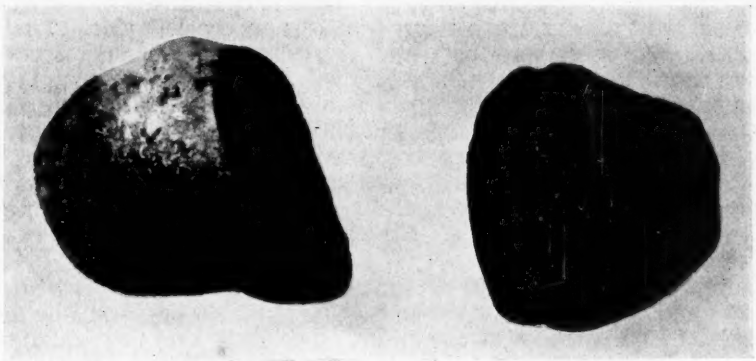

FIG. 356.—*Case* 3. Photograph of two stones removed at operation. (*Actual size.*)

Case 4.—**Common-duct stones of liver origin: cholecystostomy and choledochostomy with removal of four large stones. Recovery.**

Chung Ying Er (Case No. 85/27), female, age 28 years, unmarried, maidservant, 'from up country', was admitted on March 8, 1927, for pain in the epigastrium.

HISTORY.—The patient had suffered from colic two or three years ago, but except for this and for some irregularity of menstruation she had enjoyed good health till the present attack, which began one week prior to admission.

ON ADMISSION.—The temperature was 101·6° and the pulse 104. The patient was very restless and vomited after taking anything by the mouth. Her bowels had not acted for three days, though they usually acted every day. Pain was localized in a circular area of 5 in. diameter, the centre of the circle lying about 1½ in. below and to the right of the xiphoid process. A tumour could be felt below the right costal margin, which was thought to be an enlarged gall-bladder with enlarged liver. Bile pigments were present in the urine, but albumin was not found.

OPERATION.—The patient was taken to the theatre on admission and open warmed ether administered. The abdomen was opened through a right paramedian incision. The liver was seen to be enlarged and congested and the gall-bladder was also enlarged. The latter was opened and bile escaped, but no stones were found. A rubber tube was inserted into the gall-bladder and retained by a purse-string suture. The common duct was then exposed and incised and a round-worm seven inches long removed. On further investigation four stones were removed from the duct. The largest of these measured 1 in. by ¾ in. by 1¼ in. The common duct was drained by rubber tubing. One and a half pints of intravenous saline were administered during the operation.

All drainage tubes were removed on the sixth day. Thirty-seven days after operation the patient left hospital, free from jaundice and pain and with her wound healed.

Case 5.—**Intrahepatic stone-formation: choledochostomy with removal of small stones. Death on the ninth day.**

Ip Kam (Case No. 113/27), male, age 22 years, unemployed, was admitted to the medical wards with severe epigastric pain on March 7, 1927.

HISTORY.—Previous illnesses were small-pox at the age of 3 years, measles at the age of 4 years, and chancre at the age of 20. Two years ago he had also had a

severe attack of epigastric pain similar to the present one. His present attack began eight days before, with epigastric pain, shortly followed by a rigor and fever. The fever abated but the pain persisted, and the next day rigor and fever recurred in the afternoon. There was also some headache. The pain continued; it was not accompanied by vomiting. There was no constipation, but the appetite was poor.

On Admission.—It was seen that patient was jaundiced; bile was present in the urine, as also was albumin. Pain was felt in the epigastrium. The abdominal wall was rigid. The liver was enlarged three finger-breadths below the costal margin on the right side and two finger-breadths on the left side. The spleen was not palpable. The fæces were pale and clay-coloured. On microscopic examination no ova were found. The temperature was 103·8° and the pulse 112. A blood smear was taken; no malarial parasites were seen. The temperature fell next day and kept normal till March 12, when the patient insisted on going out. The pain had gone, but bile and albumin persisted in the urine. The next day abdominal discomfort was again felt, the appetite was poor, and the bowels did not act. Later in the day epigastric pain set in with headache, rigor, and fever. On the 14th headache, rigor, and fever recurred. On the 15th the epigastric pain was worse and the fever increased.

On March 16 the patient was readmitted to the medical wards with a temperature of 101° and a pulse of 104. The jaundice was deeper, and bile and albumin (0·05 per cent) were present in the urine. The liver was now enlarged to three finger-breadths below both costal margins. Emetine injections were given. On the night of the 18th the temperature reached 105°; on the evening of the 20th there was a rigor and the temperature reached 105·8°. The temperature was normal on the 21st and 22nd. A blood-count on the 19th showed a leucocytosis of 14,300, with 94 per cent polymorphonuclears. An examination of the fæces showed the presence of adult *Trichuris trichiura*, but no ova of any kind.

Operation.—On March 22, the patient was transferred to the surgical wards, and on the following morning under open warm ether the abdomen was opened through a right paramedian incision. The gall-bladder was only slightly enlarged, but there were some adhesions to the neck. The enlarged common bile-duct was opened, bile escaped, and two minute stones were removed and more were felt high up in the liver but could not be extracted. One and a half pints of glucose (3 per cent) and sodium bicarbonate (1 per cent) were introduced by a catheter along the common duct into the duodenum. A large drainage tube was secured in the common duct and another tube placed in the right posterior subphrenic pouch. Four days later the large tube came out by itself.

The case did not do well after operation. Fever continued and the pulse gradually rose in spite of injections of digitalin. Death occurred nine days after operation, on April 1, 1927. Post-mortem examination was performed but the notes have been mislaid.

Case 6.—**Enormous common-duct stone of liver origin: choledochostomy with removal of stone. Recovery.**

Lo Sze (Case No. 85/29), female, age 42 years, was admitted to the Civil Hospital on March 14, 1929, for pain in the epigastrium and right hypochondrium. She had been married at the age of 18 and had had three children, all then living and healthy. Her husband was alive and well. She neither drank nor smoked.

History.—Four years ago the patient had begun to suffer from frequent attacks of pain in the epigastrium and right hypochondrium. During each attack there was stabbing pain which was accompanied by vomiting, rigor, fever, headache, sweating, and general weakness. Each attack of pain lasted for a few hours and occurred two or three times a month. Chinese medicines had been taken and plasters applied without relief. For the last two months before admission the pain was much more severe and so frequent as to be almost continuous.

On Admission.—The patient complained of stabbing pain in the epigastrium and right hypochondrium. There was rigidity of the abdomen and tenderness

below the costal margin. The liver was enlarged and the gall-bladder apparently also enlarged. The tongue was thickly coated, the temperature 103·4°. Jaundice could be seen in the conjunctivæ and in the skin of the anterior abdominal wall. The urine contained bile-pigment, albumin, and epithelial casts. The patient was kept under observation till April 3. The Wassermann test was negative. The stools were examined on three separate occasions, but no *Clonorchis* ova were found. During this period the jaundice subsided and the general condition improved. On the night of April 26 a sharp 'steeple' rise of temperature occurred (*Fig.* 357). A diagnosis of common-duct stones of liver origin was made.

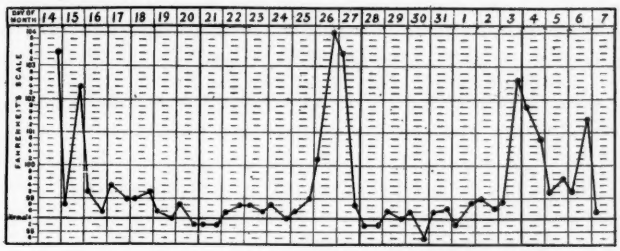

FIG. 357.—*Case* 6. Portion of temperature chart showing a 'steeple' rise in an apyrexial period.

OPERATION.—On April 3, the abdomen was explored through a right paramedian incision. The liver and gall-bladder were both enlarged and the greater omentum was adherent to both. These adhesions were divided and disclosed an enormous common duct. A longitudinal incision $1\frac{1}{2}$ in. long was made into the duct and a sausage-shaped stone $2\frac{3}{4}$ in. by 1 in. was removed (*Fig.* 358, A). Bile flowed freely. No other stones were detected. A large tube was placed in the

FIG. 358.—A, *Case* 6. A large stone removed at operation from the common bile-duct. The patient recovered. B, *Case* 7. A stone removed post mortem. The patient had refused operation. ($\times \frac{2}{3}$.)

common duct and a small drain in the right posterior subphrenic pouch. The pulse was very small and quick for forty-eight hours, but thereafter the convalescence was rapid. Bile of unpleasant odour continued to escape till the fifth day, when it suddenly stopped.

When discharged on April 28, the patient felt fit and well, the wound was soundly healed, there was no abdominal pain, the urine was free from bile and albumin, and no ova were present in the stools.

Case 7.—**Common-duct stone of liver origin: no operation. Death.**

A middle-aged Chinese man was admitted with jaundice and abdominal pain under the care of Dr. G. H. Thomas in 1928. Dr. Thomas, who has successfully operated on several of these cases (all in middle-aged men), advised operation. The patient obstinately refused surgical intervention and died about ten days after admission. At a limited post-mortem examination the stone showed in *Fig.* 358, B was removed.

Case 8.—**Intrahepatic stone-formation: choledochostomy with removal of a few small stones: some hæmorrhage. Death in four hours.**

Chou Sing (Case No. 300/29), female, age 42 years, was admitted to the Medical Unit in the Government Civil Hospital under the care of Dr. T. Y. Li on June 1, 1929.

HISTORY.—The patient was a well-nourished fat-looking woman. She habitually smoked tobacco, but only took small quantities of wine occasionally. She had married at the age of 22 and had had two children who died in infancy, and she then lost her husband. She had been constipated for a long time, and had suffered from bouts of abdominal pain on four or five occasions during the previous six or seven years. For the year before admission she had suffered from frequent attacks of palpitation of the heart. There was no history of dysentery.

The present illness began a week before admission with the onset of epigastric pain after a meal of vegetables. The pain was soon followed by nausea, and after one day by frequent eructations and regurgitation of sour fluid, but no vomiting. The pain was continuous and was increased by moving or rolling to either side. For the last three days the bowels had not acted and the abdominal pain had increased, with tenderness and distension of the abdomen. Though the pain was epigastric it had radiated to the right hypochondrium, and there was more tenderness in the right upper part of the abdomen than on the left side. There was no pain referred to the right shoulder. Appetite was poor, but there was much thirst. There was no headache.

Shortly after admission the patient experienced a rigor, the temperature shooting up to 104°. The tongue was dry, the teeth were dirty, and the gums showed pyorrhœa. No malaria parasites were seen on blood examination, and there was a leucocytosis of 22,000 per c.mm.

The liver was enlarged several finger-breadths below the costal margin; it was clinically uncertain whether an enlargement of the gall-bladder could also be distinguished. Slight jaundice was present and bile pigments were found in the urine. The urine further showed a large amount of albumin. Casts and pus cells were also reported. The pulse kept over 100 per minute and there was some cyanosis. The first heart-sound was very much accentuated, the spacing short, and the second sound hardly audible. The heart was not enlarged and there were no murmurs. No ova were found in the fæces except those of *Oxyuris vermicularis*.

OPERATION.—On June 3 the patient was transferred to the Surgical Unit and prepared for operation by rectal injections of glucose and intramuscular injections of calcium chloride. Under local anæsthesia (intercostal nerve-block, the lower six intercostal nerves below the costochondral junctions being infiltrated with a total of 20 c.c. of 1 per cent novocain solution*) an upper right paramedian laparotomy was performed. Blood was at once seen in the abdominal cavity and this was later found to be due to accidental pricking of the liver during the intercostal nerve-block, which had been rendered difficult by the fatness of the patient. Owing to the patient's straining on manual exploration, a little warmed ether was then given.

The gall-bladder was greatly enlarged; the liver was also enlarged and adherent to the diaphragm. The common duct appeared to be increased in size, but it was only with great difficulty that a few small stones were detected, one at the ampulla and the others close up to the liver. The patient's pulse was 140 per minute and very weak. One and a quarter pints of 2 per cent sodium chloride were administered intravenously. The duodenum was displaced downwards, the common duct opened, and several soft small elongated stones were extracted. A rubber tube was left in the common duct and a half tube in the right posterior subphrenic pouch. The rest of the wound was closed. When the duct was opened large quantities of bile flowed out and the sickening mawkish smell was very pronounced. Unfortunately no swab was taken for bacteriological examination.

After operation the patient kept struggling to get out of bed. The colour of

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* One hundred c.c. of 0·2 per cent β-eucaine solution were also used locally in the abdominal wall.

the finger-nails and lips remained a good red, but she died four hours after the operation.

POST-MORTEM EXAMINATION.—A clot representing perhaps half a pint of blood was found between the liver and the diaphragm, which were more or less united by old adhesions along the anterior margin of the liver. The gall-bladder and common ducts were enlarged and friable. The hepatic ducts were dilated and filled with inspissated bile. No actual calculi were present. The heart was very fatty and the aorta showed patches of atheroma. Pieces of the gall-bladder, liver, and kidney were sent for microscopical examination. All showed inflammation, but post-mortem changes prevented clear pictures.

I am indebted to Mrs. Bowes Smith for the three paintings, to Dr. G. H. Thomas for advice and for permission to refer to his cases, and to my ward clerks for their case reports which I have abstracted.

DUODENAL DIVERTICULOSIS.

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During the last fifteen months I have found two instances of duodenal diverticulosis in the dissecting-room of the Department of Human Anatomy in the University of Oxford.

First Specimen.—This was found in the body of a woman, age 63. The duodenum here shows five pouches, all in its second, third, and fourth parts, which are arranged as follows :—

Diverticulum 1.—The most proximal pouch (*Fig.* 359, 1) is 6·5 cm. from the pylorus and 4 cm. from the biliary papilla and springs from the antero-medial aspect of the bowel. It measures 2 cm. in depth and has a wide opening. There was no sign of this pouch externally ; its orifice was found when the duodenum was opened, and its fundus was then dissected out from the head of the pancreas, in which it lay much nearer the ventral than the dorsal surface.

Fig. 359.—The duodenum and pancreas from in front, showing *Diverticulum* 1 (1); the fundus of *Diverticulum* 2 (2) is seen projecting behind the upper border of the head of the pancreas. S M A, Superior mesenteric artery ; P, Pancreas.

Diverticula 2 *and* 3.—These pouches are paired and peri-Vaterine (*Fig.* 360, 2, 3). They arise on either side of the major papilla and the same plica circularis arches over all three structures (*Fig.* 361).

Diverticulum 2, the left or medial one, is 5 cm. in depth, with a bottle neck and a comparatively small opening into the bowel. The fundus lay in the head of the pancreas and immediately to the left of, and ventral to, the common bile-duct. The duct of Wirsung winds round the dorsal side of its neck.

Diverticulum 3, the right or lateral one, is 4 cm. deep and has the smallest orifice of any except *Diverticulum* 5. It lay dorsal to the descending duodenum and immediately lateral to the common bile-duct. This was the

only one of these diverticula that showed externally: its fellow was discovered by the dissector as he traced out the bile and pancreatic ducts.

Diverticulum 4.—The fourth pouch was found along the upper border of the third division of the duodenum, 5 cm. distal to the biliary papilla. It is rather cauliflower in shape, 3 cm. deep and 4 cm. across at its widest part. Its constricted neck has an orifice about the size of a threepenny bit. Its fundus was also dorsal to the head of the pancreas, which was here so atrophied, as a result of its pressure, that only a fairly thick fibrous layer separates the diverticulum from the superior mesenteric vessels.

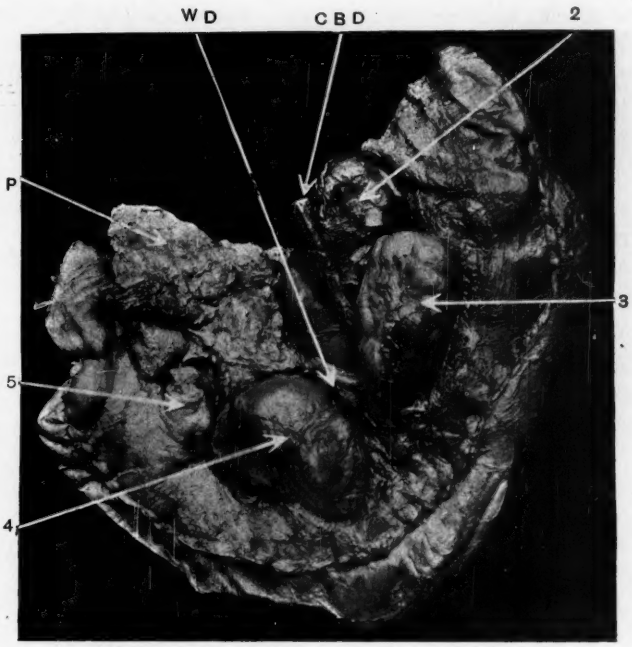

FIG. 360.—The duodenum and pancreas from behind. 2, 3, 4, and 5 mark diverticula. C B D, Common bile-duct; W D, Wirsung's duct; P, Pancreas.

Diverticulum 5.—The last pouch occurred at the junction of the third and fourth parts of the duodenum, 4·5 cm. distal to the last, to which it is similar in every way except in its size. It is only 1·5 cm. in depth. Neither of these latter pouches was found until their openings were noticed after the bowel was laid open.

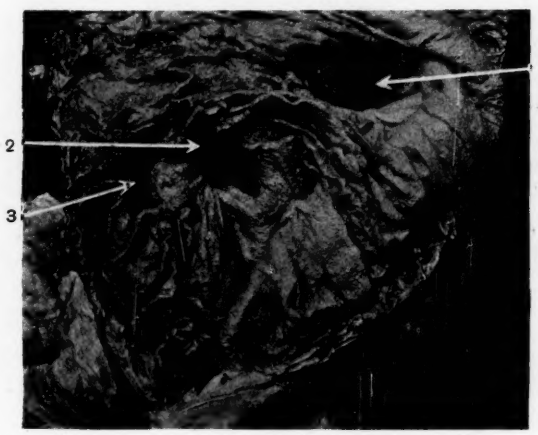

FIG. 361.—The duodenum laid open to show the orifices of *Diverticula* 1, 2, and 3 into the bowel: a glass rod is seen projecting from the orifice of Vater's ampulla.

All these diverticula were found empty—they appear in my figures lightly distended with cotton-wool—and are alike in that they have very thin walls, which appear to consist of mucous membrane only, while the muscular coat stops short at their neck, round which it forms a sort of sphincter. This is best shown in *Diverticula* 4 and 5.

MICROSCOPIC EXAMINATION OF THE WALL OF THE DIVERTICULUM.—A strip was removed to include the duodenal wall and the proximal portion of

a pouch, and this showed: (1) An abrupt cessation of both muscle coats; (2) The pouch wall composed of mucous membrane, muscularis mucosæ, submucosa, and an adventitia; (3) Lieberkühn's crypts become shallower and villi fewer and shorter as the section is traced towards the fundus. In one place, near the apex of the strip, the mucous membrane appears to recover itself partially, but for the most part it is atrophied. One group of Brunner's glands is seen in the wall of the neck of the sac, but none elsewhere.

Apart from the presence of these pouches, the duodenum appears to be normal. There is no evidence of any obstruction at the duodenojejunal flexure, nor was any other abnormality found elsewhere in the abdomen, and the diverticula apparently gave rise to no symptoms during life.

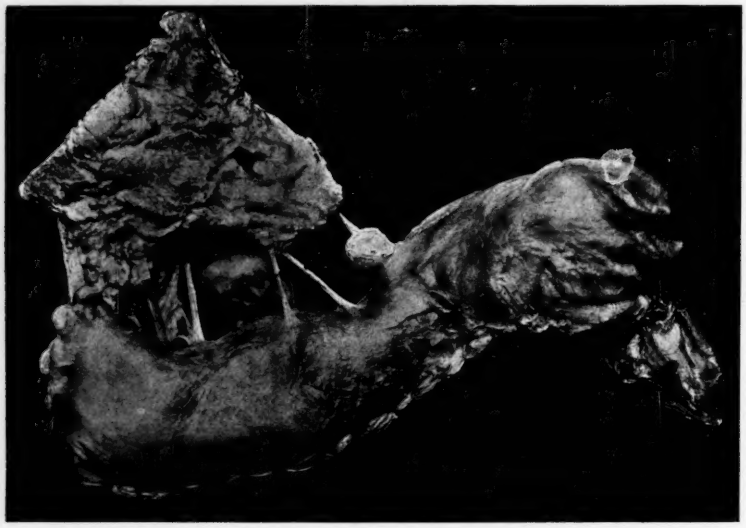

FIG. 362.—The transverse and ascending portions of the duodenum with a portion of the head of the pancreas, which has been held apart from the bowel to show the relation between the diverticula and the vessels entering the duodenal wall.

Second Specimen.—The second specimen (*Fig.* 362) came from the body of a man, age 71. Here the two diverticula are very small and arise along the upper border of the termination of the transverse and the commencement of the ascending portion of the duodenum. Both of them, when found, were empty shrivelled sacs, situated between the duodenum and the head of the pancreas, ventral to and uncovered by the latter.

The smaller of these two pouches was removed for section, and this shows exactly the same condition microscopically as in my first specimen, except that in this case the mucous membrane is much more atrophied. No other pouches were found elsewhere in the intestine, and the only other abnormality in the abdomen was a bilateral reduplication of the ureter. As would be expected, the patient never had any symptoms that could be associated with these small diverticula. The medical superintendent of the mental hospital where he died kindly informed me that he had cystitis due to an enlarged prostate, and "towards the end, a toxic jaundice".

HISTORICAL.

Chomel is always credited with the first description (1710) of a diverticulum arising from the duodenum, but this may well have been a dilatation of Vater's ampulla, as it contained twenty-two biliary calculi. Morgagni in 1761, Rahn in 1796, and Fleischmann in 1815, all described cases found post mortem; the two former each found a single diverticulum in the first part of the duodenum, the latter published three cases of multiple pouches in the second portion.

The first English record is by Harley in 1857, who found, in an old man, a diverticulum half way between the pylorus and Vater's papilla containing a large calculus. Probably, as there were adhesions at the fundus of this sac, it was rather a traction pouch, into which the stone had ulcerated. Here, too, must be mentioned Perry and Shaw's article on "Diseases of the Duodenum" in the *Guy's Hospital Reports* of 1893, in which is to be found the first critical analysis of a number of cases of this deformity, based on the Guy's post-mortem records.

Up to 1908 less than a hundred cases of diverticulosis had been recorded, and these were regarded rather as anatomical or, perhaps, pathological curiosities. In this year Rosenthal published the case of a woman, age 70, who, after suffering from a bad heart and kidneys for some years, developed jaundice and died. The autopsy showed an inflamed diverticulum, the size of a walnut, close to Vater's ampulla, dilatation of the bile-ducts, and punctiform areas of fat necrosis in the pancreas. Rosenthal considered that the diverticulum had compressed the terminal portions of both the common bile-duct and the duct of Wirsung. Again, in 1912, Bauer recorded the case of a man, age 52, on whom a gastrojejunostomy was performed for persistent vomiting. He died a few days later of pneumonia, and the only cause found post mortem for his vomiting was the larger of two diverticula, which arose from the posterior wall of the duodenum near Vater's papilla and, being 5 cm. long, had compressed the bowel above it. These two cases may be considered 'classical', as being the first recorded instances of these diverticula being responsible for the deaths of their owners, while Bauer's marks the first occasion on which an operation was performed (although unknowingly) for their relief.

In 1913 J. T. Case was the first to publish an instance of diverticulosis diagnosed during life by means of the X rays and the opaque meal. This great advance was followed in 1915 by Forsell and Key's success: a diverticulum was correctly diagnosed by X rays and then removed by operation.

FREQUENCY OF DIVERTICULOSIS.

In an attempt to form a correct estimate of the frequency of this abnormality, one is met by a variety of different percentages, depending primarily on two factors, the age of the individuals examined and the care with which the search for them is conducted. It is not surprising that dissecting-room figures are high when one remembers that most of the subjects are very aged people. Thus, J. C. B. Grant for a period injected with paraffin all duodena that came into the dissecting-room, and then found diverticula in 6 out

of 37 (16 per cent). Such a high figure is only almost equalled by Baldwin. *Table I* shows the frequency of all types of diverticula found post mortem.

Table I.—Percentage of all Types of Diverticula found Post Mortem.

Author	Post-mortems	Cases of Diverticulosis	Percentage
Linsmayer	1367	45	3·3
Baldwin	105	15	14·2
Grant	37	6	16·0

Table II shows another series of figures published by different radiologists, who are, of course, dealing with patients with some gastro-intestinal symptoms. Comparing the figures given by these five authors, we get 2·5 per cent as an average for the incidence of diverticulosis diagnosed in X-ray examinations. This agrees, perhaps only roughly, with Linsmayer's 3·3 per cent from post-mortem records. Grant's much higher percentage from the dissecting-room would seem to indicate, as Maclean suggests,[1] that the X rays

Table II.—Percentage Frequency of Diverticulosis found by the X rays.

Author	Cases Examined	Cases Diagnosed as Diverticulosis	Percentage
Case	6847	85	1·2
Andrews	2200	26	·18
Spriggs and Marxer	1000	38	3·8
Cryderman ..	770	40	5·19
J. C. McMillan (quoted by Maclean)	653	10	1·5

are only efficient in diagnosing a minority of diverticula. The two cases I record above occurred, roughly, in a period during which 80 subjects were dissected at Oxford, although I do not suggest that all the duodena were examined minutely for the presence of diverticula.

Incidence of Diverticula in the Duodenum Compared with Other Parts of the Alimentary Tract (*Table III*).—Here the discrepancies between different observers are greater. The old order of frequency, enunciated by Buschi, was colon, ileum, œsophagus, pharynx, duodenum, stomach, while it was commonly stated that Meckel's diverticulum and duodenal diverticula occurred in about the same proportion—that is, in 2 per cent of adults. This latter figure is corroborated roughly in Bunting's post-mortem records, but not by the radiologists.

Table III.—Comparative Frequency of Diverticula in Different Parts of the Alimentary Tract.

Author	Œsophagus	Stomach	Duodenum	Jejunum and Ileum	Colon
Bunting (2600 post-mortems) ..	—	—	14	15 (Meckel)	19
Case (6847 X-ray examinations) ..	—	—	85	5	138
Larrimore (3446 X-ray examinations)	9	3	19	3	71

CLASSIFICATION OF DIVERTICULA.

Different observers have attempted to divide these diverticula into groups, either, according to their appearance, into 'true' and 'false', or, according to their supposed origin, into congenital and acquired. I would suggest the following classification as being at once more comprehensive and less committal :—

I. *Primary*, where there is no obvious cause for their appearance. This would roughly correspond to the 'false' group of most, or the congenital group of some, authors.

II. *Secondary*, where there is some cause for their production, such, for instance, as a duodenal ulcer, old or recent, in their neighbourhood, or the traction of adhesions from neighbouring viscera. This is the 'true' or acquired group of different previous writers. The comparative frequency of these two groups appears in *Table IV*, in which all the diverticula arising from the first part of the duodenum may be classed as secondary.

Table IV.—Distribution of Diverticula in the Four Divisions of the Duodenum.

Author	No. of Cases	'Secondary'	'Primary'		
		1st Part	2nd Part	3rd Part	4th Part
Linsmayer (post-mortems) ..	45	4	41	0	0
Baldwin (post-mortems) ..	15	0	9	5	1
Case (X rays)	85	17	49	19	
Spriggs and Marxer (X rays)	51 pouches in 38 patients	1	30	16	4
Cole and Roberts (X rays) ..	29	3	23	2	1
Cryderman (X rays) ..	50	1	30	19	

III. Further, there is a third small group of pouches, which must be differentiated from either of the above and which are due to dilatation of Vater's papilla or possibly of the bowel wall surrounding it.

The first two varieties differ so markedly from each other in their situation, in their appearance—both naked-eye and microscopic—and in their causation, that they will be considered entirely separately hereafter in this paper.

I. PRIMARY DIVERTICULA.

The diverticula in this group are characterized as follows: (1) By their situation, being only found in the second, third, and fourth portions of the duodenum; (2) They are often multiple; (3) They always grow out from the concave border of the bowel; (4) They are always in relation to the pancreas; (5) Typically, they are flask-shaped protrusions of the mucous membrane alone through the muscular coats of the bowel, and communicate with the bowel by a constricted neck; (6) They are found best developed in people over 50 years of age.

1. Any collection of these cases constantly shows that they occur with greatest frequency in the second or descending part of the duodenum, varying from 100 per cent in Linsmayer's series to 72 per cent in Case's or 60 per cent in Spriggs and Marxer's collection of this class of diverticulum. Further, so many of these occur in the neighbourhood of Vater's papilla, that Letulle christened them 'diverticules périvatériens'. If we analyse Linsmayer's cases, we find that, out of 41, only 7 were 1 cm. or more distant from the ampulla, while in Nagel's series of 20 all were located within 3 cm. of this landmark, only 4 below it, and the others on either side or just above it.

2. In all the records of these cases there are some where there was more than a single diverticulum present. In Linsmayer's series, out of 41, 7 showed two, and 1 showed three pouches. Out of Nagel's 20 cases, 6 had two, and 1 had three diverticula. The radiologists do not find multiple pouches so frequently. Case, out of his 68 cases, collects 7 with two to four each; Cole and Roberts, out of 26, had 2 cases with two diverticula each, while 1 had three. When more than one pouch is present, the commonest occurrence is to find paired peri-Vaterine diverticula on either side of the ampulla. All Linsmayer's 7 cases were of this variety, while Letulle in 1898 said he had seen 5 diverticula arranged like a collar in this situation.

3. These primary diverticula are always found within the duodenal loop. Spriggs and Marxer, in an X-ray examination, found one growing from the convex side and simulating a cholecystoduodenal fistula, but I have found no other instance of this in the literature.

Grant found in the diverticula he described, which were both some distance below Vater's ampulla, that an injected artery bifurcated at the fundus of each sac and sat astride it. To him it looked as if the mucous membrane protrusion had occurred at the point of the bifurcation of a vessel and had carried the bifurcation before it through the muscle wall. I could not confirm this observation in my second specimen, where the smallness of the pouches and the good injection of the vessels show clearly that the terminal arteries pass alternately to the dorsal and to the ventral aspect of the bowel and that the diverticula arise between them.

4. Grégoire has classified these diverticula into three groups, according to their relation to the pancreas: (*a*) In front of the pancreas and covered by peritoneum: both the diverticula in my second specimen belong to this category. (*b*) Behind the pancreas in the retroperitoneal tissue: *Diverticula* 3, 4, and 5 in my first specimen lay here. (*c*) In the substance of the head of the pancreas: in my first specimen *Diverticula* 1 and 2 were so situated.

Any peri-Vaterine pouch on the medial side of the common bile-duct must have Wirsung's duct winding round its dorsal side. Whatever their relation to the gland may be, they lie free, so to speak, surrounded by a layer of areolar tissue, and normally can be readily separated from the gland that covers them.

5. In a very great majority of this class the diverticulum is a protrusion of the mucous and submucous coats of the bowel through the muscle, and they have been rightly called 'hernies tunicaires' by Cruveilhier or 'hernies muqueuses' by Rokitansky, or, less happily, 'false' diverticula by many observers. Even the smallest, that I have seen, comes through a definite slit in the longitudinal muscle layer, which appears to form a sort of sphincter round the neck of the sac. They naturally vary very much in their size, from about 1 cm. to 5 cm. in depth—the largest I have seen recorded is 6·8 cm. (Jacquelin and Quénu)—and in their shape, but the majority have a somewhat expanded fundus narrowing to a neck, which opens by an orifice, again of very varying diameter, into the bowel. As one discovers these sacs post mortem or in the dissecting-room, they are usually collapsed and empty, and look like grape skins devoid of their contents, or small collapsed toy balloons. Occasionally they have been found filled with chyme or containing solid particles of food. Two diverticula containing gall-stones are repeatedly quoted in the literature: they are evidently the old cases of Chomel and Harley, which were mentioned earlier in this paper, and do not belong to this class at all. When laid open the interior appears even and smooth—there is no evidence of old scarring—and usually no valvulæ conniventes are seen, although Spriggs and Marxer speak of some pouches in which "the mucous membrane was thrown into folds".

Microscopical Appearances.—Most of the reports follow very closely what I found in my cases. Thus Greder writes that usually the mucous membrane is thin and atrophied and villi tend to disappear; Lieberkühn's crypts, although less numerous, extend over the whole extent of the sac; Brunner's glands may be seen near the orifice, but are rapidly lost. The muscularis mucosæ is always well developed and may be hypertrophied. As a rule these are the only layers present in the wall of these primary diverticula—mucous membrane, muscularis mucosæ, and a thin submucous layer, blending with an adventitia; the duodenal muscle stops abruptly at the neck of the sac. In a minority of cases authors report a "muscular coat was everywhere distinct" (Jackson, in describing a sac 3·5 cm. deep); while Baldwin found all the layers of the duodenal wall present in all his 15 cases. Certainly many of the cases recorded by Baldwin were very small: taking 10 of his 15, the average depth was only 0·9 cm. Case, Seippel, and Bonneau maintain that it depends on the size of the pouch; the small ones have originally all their coats, but with increase in size the muscular coat is gradually overstretched and atrophies. Bariéty would have three types: (1) With a complete absence of muscle coat; (2) With a thin muscle layer throughout; and (3) With a muscular coat latticed and split up and disappearing in many parts of the sac. This point—the presence or absence of a muscular coat—is perhaps rather laboured in the literature of the subject, because it has been used in the past to divide up these pouches into 'true' and 'false' varieties: this

is referred to again below. Certainly my primary diverticula, in a very large preponderance of instances, are truly 'false' or mucous-membrane hernias.

Linsmayer in one case found small lobes of accessory pancreas in the wall of a shallow diverticulum. Hanau made the observation in another instance, and this also occurred in Stiles' case (reported by Spriggs and Marxer).

6. It was assumed, on the evidence of post-mortems, that these diverticula were essentially the products of old age. Thus an analysis of Linsmayer's figures show that 12·2 per cent of this class of pouch were found in persons dying under 50, 12·2 per cent in persons between 50 and 60, while 75·6 per cent occurred in persons over 60 years of age. This latter high figure is in part due to the fact that many of Linsmayer's autopsies were performed at the Vienna Infirmary. In Baldwin's series the average age was 59. Good mentions having seen them at a post-mortem on a woman of 26.

The ages at which they have been discovered by radiologists are somewhat lower: Spriggs and Marxer give 55, Cryderman 51·7 years, as average figures, with 20 and 24 as their youngest records respectively. But turning to patients that have been operated upon for this condition, it is surprising to find that the mean age for the 20 operated cases of which I have records is 47 years. The youngest patient was a woman of 27 (Huddy). Further, many of these cases gave a long history of indigestive symptoms—for example, Jacquelin and Quénu's patient, operated upon at 54, had a thirty years' history of gastric trouble.

The presumption from this is that, as Bonneau says, the abnormality, or its *Anlage*, exists in young people, and it is only in those that have worn badly or in those of advanced age that such pouches increase sufficiently in size to become either sources of trouble during life or objects of interest after death. Such growth in diverticula has been noticed by Spriggs and Marxer. In two patients, re-examined by X rays after four and seven years respectively, the development of a pouch from a small to a large size was observed; while in another case of a woman, age 48, small saccules were seen round the biliary papilla where none had been seen six months earlier by the authors, or twelve months before that by another radiologist.

Sex.—Nearly all collected records show that these 'primary' pouches are more common in females. Putting Linsmayer's, Spriggs and Marxer's, and Cryderman's figures together, we find them occurring in 77 women to 47 men. This preponderance is proved to be more striking still when we inquire into the sex of the operated cases: in this group there are 19 females with but 2 males.

ETIOLOGY.

On attempting to investigate the cause of these 'primary' diverticula one is at once confronted by a mass of different theories, one or two of which may perhaps hold for about the same number of cases, while many of the conditions supposed to be responsible for them have never been found accompanying them.

The 'Acquired' Theory.—The older observers were inclined to regard them as acquired pouches. This assumption largely depended on the fact that post mortem they were found, as a rule, in very elderly people. The

ages given above of those patients operated upon for this condition are a sufficient refutation of the idea that these diverticula occur only in advanced life. They were regarded as either: (1) *Pulsion*; or (2) *Traction* diverticula.

1. Pulsion Diverticula.—Under this heading would fall two groups of supposed causative factors, possibly acting in combination.

a. Intraduodenal Pressure.—Perry and Shaw maintained that the pressure within the duodenum was normally greater than in the jejunum or ileum, owing to the presence of the pylorus, which opposed reflux, and mention an observation of Moore's, who found jejunal diverticula below a partial congenital occlusion at the duodenojejunal junction. I do not know that there is any foundation for this theory. Keith and Jach suggested that chronic obstruction was responsible for their formation, such obstruction being caused, as a sequel to visceroptosis, by the superior mesenteric vessels as they cross the transverse part of the duodenum. In this connection Cryderman mentions that W. J. Mayo found colonic diverticula above an obstructing carcinoma in 31 per cent of his cases. If this were the cause, it is remarkable that in none of the cases of chronic duodenal ileus reported of late years (Hurst, Wilkie, Higgins, and McConnell and Hardman between them record 146) were any pouches found. Again, Jewesbury found no diverticula in a case of congenital stenosis at the junction of the second and third parts of the duodenum, which only admitted a probe.

b. Weak Spots in the Bowel Wall.—

i. *Anatomical.*—Klebs first suggested that there was a relation between the points of entrance and exit of blood-vessels and the sites of origin of diverticula. Following him, Hansemann and Fischer both concluded that the mucosal hernia occurs originally along the path of a perivenous connective-tissue sheath. This theory has been elaborated by Graser in the case of colonic pouches, and by Heidecker in the case of duodenal pouches, both of whom consider that portal venous stasis causes a distension of these veins; whenever this stasis diminishes, potential spaces will be left in the bowel wall which were previously filled by the congested vessels. Some experiments performed post mortem were thought to have some bearing on this matter. Heschl and Good, by artificially distending dead bowel, caused either a complete rupture (Heschl) or a trench-like furrow with rupture of the circular muscle (Good) at the mesenteric border of the bowel, while in the same way Hansemann and Palma produced artificial small sacculations along the mesenteric border of senile intestine, corresponding to the points of exit of veins. Contradicting these, Chlumsky found in living animals that the bowel always ruptures, under pressure, at its antimesenteric border.

Peri-Vaterine diverticula have been put down to weakening of the bowel wall caused by the entrance of the common bile and Wirsung's ducts (Fleischmann), but Letulle and Nattan Laurier pointed out that in the adult the muscle coat is stronger here than elsewhere.

Linsmayer, who found pancreatic lobules in the wall of a diverticulum, has also found them in the muscular and submucous coat of three normal duodena near Vater's papilla in young subjects. In the discussion subsequent to his paper Helly and Orth both agreed with this. I could not confirm this in the sections of any of the fœtal duodena I examined. Linsmayer

maintains that these aberrant bits of pancreas cause weak spots in the bowel wall, which in later life may allow hernial protrusions to occur through them.

ii. *Pathological.*—Roth found in one case of diverticulosis fatty degeneration of the mucous membrane and muscle of the neighbouring intestinal wall. It occurred in an old man who had an ulcer scar in the first part of the duodenum. This observation has not been confirmed by others; in my case of five diverticula, sections of the duodenal wall near the pouches and elsewhere showed no evidence of fatty change.

As a cause of this class of primary diverticulum old ulceration can be briefly dismissed. Not only are ulcers very infrequent in the descending duodenum, but neither do these pouches nor the bowel near their orifices show any evidence of scarring of the mucous membrane. There is, however, a group of cases where the following combination occurred: diverticula in the second part of the duodenum with an ulcer in the first part, or, in one case (Roth), with a cicatrized ulcer of the lesser curvature of the stomach. I have found records of ten such occurrences in the literature, and all, except one (Moore's), were typical peri-Vaterine pouches. While Polgar suggests that abnormal duodenal tone or peristalsis may cause such pouches, it is better, I consider, with Nagel, to regard such instances as coincidences, and not to try to connect the presence of the ulcer above with such apparently primary diverticula.

2. Traction Diverticula.—

a. Traction by an atrophic pancreas was suggested by Roth as a cause for diverticulosis. In answering this, Wilkie points out that in the most marked cases of pancreatic atrophy recorded there have been no duodenal pouches, while such pouches are always separated by a loose connective-tissue sheath from the pancreas, which is indented by them. Again, it is difficult to understand why such traction on the duodenal wall should be localized at a few spots only.

b. Keith suggested that traction by the common bile-duct, which, stoutly coated and inelastic, has its upper end fixed to the diaphragm by the gastro-hepatic omentum, might, in cases of visceroptosis, pull out the duodenal wall. This, as Wilkie points out, would produce a funnel-shaped diverticulum, with the biliary papilla at its apex, which is very different from anything I am considering at present, and will be again referred to below.

The 'Congenital' Theory.—Most recent writers on this subject have regarded these primary diverticula as of congenital origin. As Nagel says, "Whatever the time or the cause of their appearance, these diverticula are formed on a developmental basis, as they occur at actual or potential congenital weak spots in the bowel wall." When, however, one attempts to collect facts for such an assertion, one is met with a great deal of conjecture and little good evidence. The following facts are made the most of:—

1. The frequent multiplicity of these diverticula.

2. Their occasional occurrence with other diverticula elsewhere in the alimentary tract. Thus, they have been found with Meckel's diverticulum once (Perry and Shaw); with a diverticulum of the œsophagus once (Letulle); of the stomach once (Downes); of the jejunum and ileum five times (Hansemann—400 pouches in all—Seippel, Berblinger, Nagel, and Heidecker);

and of the colon six times (Bell, Akerlund, and Nagel). Downes mentions the case of a woman, age 39, who had a diverticulum in the cardiac end of the stomach, two in the duodenum, and many throughout the small intestine and the whole of the colon.

3. While it is rare to find them in infants or in early life, certain observers report them. Simmonds, in the discussion on Linsmayer's paper, says he had occasionally seen diverticula in the first part of the duodenum in young children, but none occurring lower down, except in older people. Shaw is quoted by Linsmayer—without giving any reference—as having found a duodenal diverticulum in a newborn child above a congenital atresia of the bowel. I fear that these two observations do not help to explain the pouches I am considering, which, as has been said, are found exclusively in the second, third, and fourth portions of the duodenum.

4. The embryology of the duodenum. Keibel and Tandler were the first to call attention to the extraordinary activity of the duodenal epithelium after it has given off the hepatic and pancreatic outgrowths. It proliferates so quickly that the lumen of the bowel is occupied by a series of 'vacuoles', some of which produce outward bulgings into the surrounding mesenchyme and so definite diverticula are produced (Lewis and Thyng, Johnson and Elze). In the jejunum and ileum many more of these pouches occur than in the duodenum. In reconstructing the duodenum and pancreas in a 14-mm. embryo I found such a diverticulum just at the duodenojejunal junction (*Fig.* 363) and two more farther down in the jejunum. For two reasons most observers are agreed that these evanescent outpocketings—they have disappeared in the 24-mm. embryo, as a rule—can scarcely be responsible for diverticula in the adult, although Johnson found in one case a large persistent pocket in the mid-region of an embryo 134 mm. in length (about 4 months). In the first place none of these pockets occurred in the neighbourhood of the common bile-duct. The one I figure was very similar in position to that in Lewis and Thyng's model, and I would suggest that both of them are rather on the jejunal side of the flexure. Again, in any case, they are situated on the antimesenteric side of the bowel.

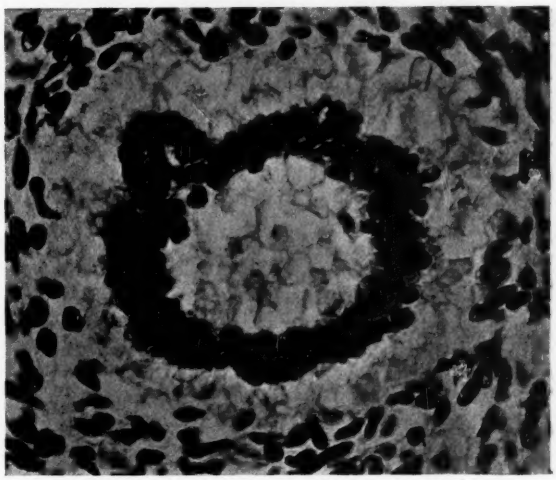

FIG. 363.—A section through, or just beyond, the duodenojejunal junction, showing a diverticulum in an embryo 14 mm. in length. (× 430.)

As peri-Vaterine pouches are such a common variety of these diverticula, and as I do not think this region has previously been systematically looked at in older fœtuses from this point of view, I examined serial sections of the

duodenum and biliary papilla from fœtuses 6·5 cm., 8 cm., 14 cm., and 16·5 cm. in length, and at full term. I wanted to see: (1) If the muscle coat of the bowel is weakened at the junction with it of the common bile and pancreatic ducts; and (2) If I could find any evidence of abnormal proliferation of the mucous membrane or of aberrant bits of pancreas in its wall. With regard to the ducts, I found apparently two different conditions in different fœtuses. In one, 6·5 cm. in length, the circular muscle appears to be parted so obliquely by the common bile-duct that it looks like the leaves of a partly-opened folding door, and this, I would suggest, is the usual arrangement. In an older one, 14 cm. in length, on the other hand, the muscle seems abruptly interrupted by the duct and there is a small space on either side of the latter where the muscle appears non-existent. Here there do seem potential weak spots, which do not exist in the earlier specimen. My second microphotograph (*Fig.* 364) shows the biliary papilla from a 16·5-cm. fœtus (about 5 months). What strikes one about this is, first, the very large size of the papilla, which bulges so much into the bowel lumen as to make it ∩-shaped; and, secondly, the vessels piercing the muscle on either side of the papilla, not obliquely, but at right angles to it. It may be fanciful, but it appears to me that in this section the stage is set almost for the formation of weak spots on either side of Vater's papilla. A Lieberkühn's crypt has only to grow down a little deeper than usual and it would be very near a perivascular connective-tissue sheath, and by further growth would soon be parting the circular-muscle.

FIG. 364.—A section through the biliary papilla in a fœtus 16·5 cm. in length. At A vessels are seen piercing the muscular layers of the duodenal wall. (× 30.)

These isolated observations of mine do not, of course, prove anything, and, as will be at once recognized, there is much conjecture and no good evidence for the developmental origin of these pouches. As they may occur in any of the three lower divisions of the duodenum, and as they often appear simultaneously in two or in all three divisions, a common cause should be found for them (Wilkie). For this reason, while the passage of the common bile-duct through the muscular wall might account, in the fœtus, for the occurrence of congenital weak areas in this neighbourhood, this could not explain diverticula occurring elsewhere, and one would prefer to suggest a like origin for them all. The common paths that the mucous membrane can take through the muscle are provided by the perivascular sheaths. Hansemann and Fischer first suggested this, but they thought that the whole

process occurred after middle life and that the pouches had no congenital basis. Possibly, as Holzweissig has suggested, this path may be straighter than normal owing to the vessels passing less obliquely, or at right angles, to the muscle. As Fischer points out, once the mucosal hernia has started along the path of a venous sheath, it will follow the path of least resistance, and this may or may not be the sheath of a blood-vessel.

Why should the mucous membrane invade the muscle? There is no evidence as to whether this is due to the actual persistence of vacuoles which should have normally disappeared before the embryo is 9 weeks old, or to an abnormal persistent tendency to epithelial proliferation, or whether, as Payr imagines, there is a congenital weakness of the mesoderm which permits it to do so. Tandler and Forssner suggested that the vacuolization was an expression of unequal growth-rates between the epithelium and the surrounding mesenchyme, and this same explanation would, I think, probably serve as an answer to the above question.

In any case, the pouches we are now considering are probably due to congenital *loci resistentiæ minoris*. At certain places the mucous membrane has pierced, possibly only partially, the muscular wall, and at these spots normal wear and tear will produce pulsion diverticula. Further, the extent to which the mucous membrane has invaded the muscular coat before birth may account for the variation in the condition of the adult diverticular wall. If it has found its way completely through the muscle, the pouch will be the common mucous membrane hernia; if only partially, the pouch will be clothed by a variable amount of the muscular coat.

Lastly, is there any reason why the first part of the duodenum should be exempt from the incidence of these pouches? Certainly it is true that the mucous membrane of what will eventually become this portion of the bowel does not proliferate and vacuolize: this only commences just above the level of the emergence of the dorsal (the accessory) pancreatic duct. By the same token, in the adult, valvulæ conniventes are first found at a distance of from one to two inches from the pylorus and at first they are very small and scattered. Possibly both these facts may indicate an inherent difference in the activity of the epithelial growth in the first portion of the duodenum.

PATHOLOGY.

In the great majority of cases these diverticula are found as I have described them—empty sacs, lying in a bed of areolar tissue in relation to the head of the pancreas. They probably owe their comparative immunity from inflammation to: (1) The sterility of the duodenal contents; (2) Their retroperitoneal situation, which may allow of their easy distension (Greder); and (3) The dependent position of their opening into the bowel—this opening, while of varying size, being usually sufficient to ensure the easy emptying of their contents. Again, this opening, in the cases I have examined, was so well concealed by the valvulæ conniventes that only a careful search revealed it, while Case recommends (*see below*) that considerable pressure should be put on the duodenojejunal junction, after a barium meal, to ensure diverticula being filled sufficiently to render them visible on the fluorescent screen. Both these facts make one curious as to whether these sacs are normally filled with

chyme or not. On the other hand, some of them, once filled, do not empty themselves readily—they have, of course, no muscular coat—and Case found barium retained for seven days in one case. Such distended sacs can cause either distortion or actual obstruction of the duodenum or of the common bile-duct.

Mechanical Effects of a Distended Diverticulum.—

On the Duodenum.—Jacquelin and Quénu found in a woman with a thirty years' history of digestive trouble a large diverticulum, 6·8 cm. long, arising just proximal to the duodenojejunal junction. At the operation the distended fundus of this presented between the gall-bladder and the duodenal bulb, and had so deformed the duodenum that its third part ascended almost vertically behind the second part and wholly to the right of the mid-line. With this there was dilatation and stasis of the genu inferius. Six months after the removal of the sac an X-ray examination showed a normal course for the duodenum and no stasis. Bauer's case of duodenal obstruction from diverticulosis has been already referred to above.

On the Common Bile-duct.—Bengolea, in 1928, reported the case of a woman who had had three attacks of jaundice. At the operation he removed a distended gall-bladder and found the bile-ducts free from stones. Two months later jaundice recurred and further radiography showed a diverticulum near Vater's ampulla. The author considers that the jaundice was due to intermittent obstruction of the common bile-duct by the retention of intestinal contents in this pouch.

Marie found post mortem, in a case of bilateral peri-Vaterine pouches, a regular dilatation of the common bile-duct without any obvious obstruction, and Specimen 6284.1 in the Royal College of Surgeons Museum shows a pouch 2 cm. above the biliary papilla with some dilatation of both common and cystic ducts.

The commoner way in which these diverticula become pathological is from inflammation in their wall. Diverticulosis becomes diverticulitis. Once this has occurred, it may go on to necrosis or perforation of the sac and the neighbouring pancreas may be infected.

Diverticulitis.—In Rosenthal's case, quoted above, the wall of the pouch consisted of granulation tissue without epithelium. Huddy, in 1923, removed from a woman, age 27, a pouch arising from the second part of the duodenum ; this was thin-walled and black in the centre, while the mucous membrane was necrotic. Monsarrat, in 1926, found at operation a perforated pouch arising from the posterior wall of the descending duodenum. With this there was a chronic ulcer of the first part.

Peridiverticulitis.—Case reports an operation at which it was found quite impossible to excise a diverticulum owing to its firm adhesions to the pancreas, while in two out of four of Maclean's operated cases adhesions were found. In one of these the pouch was embedded in the pancreas, and swabs taken from the raw surface of the latter showed the presence of *B. coli* and staphylococci.

Further, owing presumably to retention, the contents of a pouch may become septic, and this, reaching the duodenum, may cause a duodenitis, and from this an infection of the biliary and pancreatic ducts may follow.

Duodenitis.—Spriggs and Marxer noticed in one case a persistent contraction of the bowel wall below the opening of a diverticulum, suggesting that the duodenum was being irritated by the escaping contents of the sac. Bauer found post mortem a pouch below Vater's papilla, full of greyish fæculent material: the duodenal mucous membrane was red and inflamed, the papilla was swollen with its lips glued together, and there was some dilatation of the common bile-duct. Here should be mentioned a curious case, recorded by Schmidt and Ohly. A woman, age 28, who had had abdominal discomfort from early girlhood and had symptoms of chronic pancreatitis—loose stools rich in fat—was found by the X rays to have a dilated duodenum. This was thought to be due to old gall-bladder adhesions. At the operation the duodenum was dilated to the size of an empty stomach, with some diverticula (there is no record of how many pouches there were or where they were situated). There was no stenosis at the duodenojejunal flexure or any obvious cause for the duodenal dilatation. There was no autopsy, and it is questionable how far the diverticula had any connection with the condition of the duodenum. Again, Melchior found that three out of nine cases of phlegmonous duodenitis had diverticula.

Cholangitis, Gall-stones, and Acute Pancreatitis.—Versmann, in 1919, found in two cases after death stones in the common bile-duct with diverticula just below the papilla. A third patient had had his gall-bladder and the calculi therein removed, the bile-passages being found free. Jaundice, however, persisted, and he had subsequently five unsuccessful operations for this condition between 1914 and 1917. At the autopsy a duodenal pouch was found just below the papilla, which admitted the tip of the little finger. Wilkie, in 1913, published the case of a man who was found post mortem to have biliary calculi and acute pancreatitis, while one inch above Vater's papilla was a diverticulum. In all these cases the authors consider that the diverticula were responsible for the formation of gall-stones.

Chronic Pancreatitis.—Bell found in a woman, who died of arteriosclerosis and gangrene, three duodenal diverticula, one of which was close to the major papilla; further, there was a marked chronic pancreatitis and slight periportal hepatic cirrhosis.

Carcinoma.—As carcinoma of the small intestine is such a pathological curiosity, it is not surprising that, in contrast to W. J. Mayo's finding for the colon (where he found diverticulosis occurring in 31 per cent of cancer cases), no case of carcinoma of these primary diverticula has been recorded. Maclean, however, suggests that, as carcinoma is more prone to develop in an organ that has become cirrhotic, it is conceivable that in some cases of cancer of the head of the pancreas an overlooked diverticulum may be the exciting cause. Schaefer records the case of a man who died of a carcinoma of the tail of the pancreas, in which two diverticula, one the size of a hen's egg, the other of a child's fist, were found in the inferior part of the duodenum.

SYMPTOMS.

There are no certain symptoms or signs which are pathognomonic of these pouches. Bensaude has suggested five predominant groups of symptoms, which may be said to indicate possibly progressive stages of the pathology.

1. **Vague Digestive Disturbances.**—A feeling of heaviness and distension after food, perhaps of nausea, but no actual vomiting; sometimes there is diarrhœa. Typically, there will be a long history of such discomforts, which so often occur in the 'chronic abdomen'.

2. **The Ulcer Type.**—With pain, habitual vomiting, and possibly hæmatemesis. These cases will present a varying amount of epigastric tenderness. Oehnell found considerable pain in 85 per cent of these cases, local tenderness in 29 per cent, and vomiting in 44 per cent. Spriggs found that 5 out of 18 patients with this condition were tender on palpation. The following are some typical case reports:—

Basch (1915): A woman, age 36, had been troubled with indigestion as a child, 'sour stomach', heartburn, and flatulence. Six years previously she had appendicitis and her appendix was removed. Her indigestion persisted, and in addition she began to have a sharp aching pain below the gall-bladder region one to two hours after food. On examination there was some general enteroptosis and the gall-bladder region was tender on pressure. Chemical examination of the stomach was negative. She was found to have a diverticulum of the third part of the duodenum; there was nothing else amiss in the upper abdomen.

Larimore and Graham (1927): A woman, age 63, gave ten years' history of gas and distension after meals, diarrhœa alternating with constipation, and vomiting. She had lost 20 lb. in weight and had achlorhydria. She was proved to have a diverticulum of the third part of the duodenum; all else was normal.

Two other occasional and rather curious symptoms should be mentioned:—

a. Hæmatemesis.—Spriggs and Marxer reported that two of their eighteen patients, in whom diverticula were apparently wholly responsible for the illness, had this symptom, while Robineau, in 1921, records the case of a woman, age 39, who, with a history of several years' vague discomfort, suddenly had a very large hæmatemesis. A pouch was found springing from the fourth part of the duodenum and removed; nothing else was discovered to account for the hæmorrhage, and there was no ulceration of the diverticular mucous membrane.

b. Colitis.—Diarrhœa is mentioned as a concomitant symptom in several case reports. Lipschutz records that a woman with two diverticula had a four months' history of this complication. Spriggs noticed it in three of his patients, who also had pain in the left lower abdomen, and suggests that possibly these colitis symptoms are caused by the irritation of putrefactive material from the duodenal pouches. The woman from whom my first specimen came was described as an 'old colitis case'.

3. **Incessant Vomiting.**—In this group the vomiting becomes incessant, suggesting pyloric or duodenal stenosis or, possibly, carcinoma of the pylorus. Haudek records the case of a woman, age 60, who gave a long history of stomach trouble; recently the vomiting had been frequent, with great loss of weight. The X rays showed a diverticulum of the third part of the duodenum and some smaller ones at the duodenojejunal flexure and beyond this. She died as the result of these, and their presence was confirmed at the autopsy, which showed nothing else pathological.

4. **Cholangitis Type.**—In peri-Vaterine diverticula jaundice of a varying degree may occur, and with it paroxysmal crises simulating biliary colic. Spriggs notes that one case out of his eighteen had attacks of jaundice; Oehnell records one case of cholecystitis out of his thirty-four. The more severe and persistent cases of Bergolea and Versmann have already been quoted.

5. **Pancreatitis.**—Akerlund's case was that of a woman, age 68, who had a long history of stomach trouble; X-ray examination showed a diverticulum of the third part of the duodenum, which readily emptied itself of barium, together with a dilatation of Vater's papilla and of the termination of the common bile and pancreatic ducts. These still retained barium after twenty-four hours. A few days after this examination she had an attack of intense abdominal pain with repeated vomiting; the right side of the abdomen was rigid and her temperature slightly raised. Directly the acute symptoms had subsided, an operation revealed a necrotic mass in the head of the pancreas, the size of a hazel nut, and further small necrotic centres to either side of this. No duodenal ulcer could be felt and there was no perforation of its wall; the gall-bladder was empty and normal. The necrotic area was drained and a posterior gastrojejunostomy performed, and the patient got quite well.

Case describes the case of a woman, age 45, who had gastric symptoms for six years. A radiogram showed a pocket the size of a hazel nut at Vater's ampulla, in which barium was retained for nine hours, and a diverticulum in the third part of the duodenum. The diagnosis, on clinical and X-ray grounds, was chronic pancreatitis, possible cholelithiasis, and a duodenal pouch. An operation found the diverticulum behind the head of the pancreas, to which it was intimately adherent; the head of the gland itself was enlarged. The diverticulum could not be removed; a cholecystostomy was done and the patient was relieved.

Both Akerlund's and Case's patients, it must be noted, had dilatation of Vater's papilla as well as diverticula. Akerlund maintains that the diverticulum was the primary cause; this set up a duodenitis, by which Vater's ampulla and the ducts were subsequently infected. Case has, however, X-rayed fifteen patients with retention of barium in the ampulla, and in only half of these were duodenal pouches present. The pancreatitis is obviously secondary to the condition of the ampulla, so it is arguable that the diverticulum, in each case well distal to this orifice, had little to do with its occurrence.

Of Oehnell's thirty-four cases of diverticulosis, two were associated with a chronic pancreatitis.

DIAGNOSIS.

No case has yet been accurately diagnosed on clinical evidence. The usual tentative diagnosis is duodenal ulcer, gall-bladder disease, or, in a few cases, chronic pancreatitis. The only method of diagnosing these pouches is radiography after an opaque meal. As Case was the first to discover them by this method in 1913 and has done a great deal of work to perfect its details, I give his technique in his own words:—

After taking the usual barium meal and after a brief examination standing upright, the patient is asked to lie on his right side, so that gravity may aid in filling niches or sacculations in the pyloric zone. When all is ready for the patient to turn over, the observer, standing on the patient's left, makes strong pressure with his gloved left hand over the duodenojejunal junction, at the same time pressing the contents of the stomach towards the pylorus. The patient is then asked to inhale, hold his breath, and turn quickly on his back, while compression of the duodenum is maintained, thus artificially producing obstruction near the duodenojejunal junction and incarcerating the duodenal contents. A wooden spoon may be used instead of the hand.

After a pouch is discovered by the fluorescent screen, the following points about it should be noted: (1) its size and shape, (2) its situation, (3) the dimensions of its orifice, (4) its mobility, (5) the length of time the barium is retained, and (6) the relation of the shadow to any point of tenderness on pressure. All writers are agreed on the importance of making frequent screen examinations. Further, Case suggests that a stereoscope may help to show whether the shadow of a pouch is dorsal or ventral to the pancreas.

Shadows cast by primary diverticula will be differentiated:—

1. From barium lodging in the crater of a duodenal ulcer, by the situation of and by the short retention of the opaque meal in the latter, while an ulcer shadow will be tender.

2. From both classes of pouch secondary to ulcers (*see below*), by their situation.

3. From traction diverticula due to adhesions. These will be found, almost exclusively again, in the first part of the duodenum, or if they arise lower down, will occur on the convexity of the bowel wall.

4. Akerlund has drawn attention to the difficulty of distinguishing Vaterine (*see below*) from peri-Vaterine diverticula. He suggests that the shape of the shadow would help, and Baensch says that the fundus of a Vaterine dilatation will be parted into two little bays, corresponding to the termination of the bile and pancreatic ducts.

5. Polgar warns radiographers against certain 'pseudo-diverticula'. Such abnormal shadows may be caused by the bulge of the contiguous duodenal wall towards a scirrhous carcinoma of the head of the pancreas, or by a cholecystoduodenostomy; spastic or organic narrowing of the bowel, secondary to an ulcer, will probably produce a deformity of the whole duodenal lumen.

Larimore and Graham have published the notes of an interesting case in this connection. A man was found by an X-ray examination to have a diverticulum to the left of the second part of the duodenum, in which barium was retained for six hours. At the subsequent operation no evidence of an ulcer or actual pouch was found, but five inches from the pylorus a fold of duodenal wall was bound down by adhesions to the rest of the bowel, forming really a side pocket of it.

The three characteristics of a true diverticular shadow which, according to Bonneau, are sufficiently diagnostic, are: (1) its mobility to the finger, (2) its insensibility on palpation, (3) its persistence. While normally the duodenum is completely emptied in four hours after an opaque meal, a diverticulum will contain barium 11, 24, or 48 hours later, and in one instance it was still evident after the lapse of seven days (Case).

PROGNOSIS.

In contrast to the instances of the grave complications of these diverticula collected from various sources in the preceding paragraphs, it must again be remembered that in the great majority of cases found after death there is no history indicating that they ever caused trouble during life. The first of my cases with five diverticula, three of which are of a considerable size, died in 1927 of pneumonia at the age of 63, and the superintendent of the mental hospital where she spent most of her life writes: "There is nothing in our records bearing on the point you mention, except that she was an old colitis case, but she has not been treated for any complaint for many years, and was a patient here since 1880."

Case, on the other hand, in 1920, pointed out that diverticula discovered during life are in a different category, in that people do not take opaque meals and are not X-rayed unless they are suffering from a certain amount of abdominal disability, while only those pouches that retain barium for a certain time can be so diagnosed. He suggests, therefore, that the diagnosis of a diverticulum generally means surgical treatment. Clairmont and Schinz in the same year said the same thing: "A diverticulum is a source of all possible dangers for its bearer, and is on this account an indication for surgical interference."

The first difficulty, after such a diverticulum has been discovered, is to judge how far it, and it alone, is responsible for the symptoms complained of. Out of Maclean's 16 cases the symptoms could be entirely accounted for by other abdominal lesions in 4, while in Spriggs' series of 38 cases in only 18 were the pouches judged to be the cause of the patient's trouble. Haudek, in 1924, after studying the results of operations for diverticula, went so far as to say that in no case has the removal of the pouch cured the abdominal symptoms for which the operation was performed. For example, Forsell and Key removed a diverticulum successfully from a patient in 1915, but in 1922 Oehnell found that she still had the same symptoms of enterocolitis. Again, Clairmont and Schinz removed a duodenal pouch, but an operation performed ten weeks later owing to continual illness revealed a large carcinomatous ulcer of the pyloric part of the stomach. Only one of Haudek's own cases came to operation. This was a man with a peri-Vaterine pouch. At the operation it was felt, but could not be seen, and, as there was no evidence of any inflammatory changes around it, it was left alone; a chronic appendix was removed and he was cured for six months. Then he had symptoms of cholelithiasis: some, I expect, would suggest that the diverticulum was responsible for the latter.

Polgar quotes the case of a man who had had vague gastric symptoms for a year. An X-ray examination showed a diverticulum in the transverse part of the duodenum. Four days later he had an attack of acute appendicitis; his appendix was removed and he has been perfectly well for the last eighteen months.

Assuming that such other lesions as these have been ruled out and the presence of the diverticulum is believed to be solely the cause of the symptoms presented, are there any guides as to prognosis and treatment? Such indications may be classified thus:—

1. Attacks of 'diverticulitis', indicated by pain and tenderness on pressure, must be taken seriously. The cause of these attacks is questionable. Bariéty wondered if possibly torsion of a pouch might occur; more probably are they due to distension or over-distension of a pouch, possibly usually empty; or perhaps to some temporary gastric insufficiency, which allows solid particles of food to get into it (Greder). Maclean found these symptoms in 12 out of his 16 cases. At the same time, as Jacquelin and Quénu point out, the case histories show very often that spontaneous cures of all symptoms may occur, and that, if troubles recur, the chance of a fatality is very small.

2. The X rays will help in several ways: (*a*) The length of time that barium is retained. A pouch that easily empties itself has presumably a wide orifice and is thereby the more innocuous. Case has found that diverticula in the third and fourth parts of the duodenum appear to empty themselves more readily than those about Vater's papilla. (*b*) Further, is this orifice dependent in the patient's ordinary position? Akerlund has found that a pouch may only fill with barium in the recumbent position. (*c*) Case suggests that the situation of the pouch in relation to the pancreas is of importance: a pouch of which the fundus lies ventral to the head of the pancreas, is more dangerous than one lying dorsal to it or in its substance. (*d*) Evidence of dilatation of Vater's ampulla, secondary to a diverticulum (Case and Akerlund). Whenever this occurs, there is the possibility of a cholecystitis or a pancreatitis supervening.

3. The effects of a few weeks' medical treatment. Spriggs found that 13 of his 18 cases were thus entirely corrected, 4 were much improved, and only 1 case—a man with multiple diverticula and achlorhydria—was operated upon (gastrojejunostomy).

I would suggest that the majority of cases belong to Bensaude's first group, and that if any accompanying gastric insufficiency is corrected, they will get along with little discomfort, while the risk of future complications is so slight that it can be practically discounted. Greder, summing up this question, says: "Duodenal diverticula are less serious than a Meckel's diverticulum or than diverticulosis of the sigmoid. Occasionally they give rise to troubles, and exceptionally they menace the lives of patients."

TREATMENT.

The medical treatment which Spriggs has described aims at three things. In the first place, by means of the X rays the best position for the patient to assume in order to allow of easy emptying of the diverticulum is determined, and he is advised to adopt this after meals. Secondly, an attempt is made to keep the bowel and the pouch lubricated and disinfected by means of liquid paraffin and Kerol capsules. Lastly, attention is paid to the digestion, and everything done to tone up the whole alimentary canal. These methods seem to have met with a great measure of success. Case, on the other hand, does not consider that any form of non-surgical treatment will do any good.

I have found recorded in the literature only 23 cases where operations have been performed for primary diverticula (*Table V*). Excision of the pouch, first done by Forsell and Key in 1915, is obviously the ideal treatment. This has been done in 18 of the cases with no fatality; in one case

Table V.—Twenty-three Cases of Primary Diverticula Treated by Operation.

Author	Sex and Age	Part of Duodenum	Operation Performed
Maclean	M. 37	Fourth	Excision of pouch
Maclean	F. 58	Second	Excision of pouch
Maclean	F. —	Third	Excision of pouch
Robineau	F. 39	Fourth	Excision of pouch
Rave	F. 53	Second	Gastrojejunostomy with pyloric exclusion
Downes	F. 53	Third	Excision of pouch
Downes	F. 39	Third	Excision of two pouches
Moore	—	Second	Excision of pouch
Akerlund	F. 68	Third	Gastrojejunostomy with drainage of necrotic pancreas
Le Jemtel, Andreoli, and Maratuech	F. 39	Second	Excision of pouch
Jacquelin and Quénu ..	F. 54	Fourth	Excision of pouch
Lecène..	F. 52	Second	Excision of pouch
Forsell and Key	F. 41	Fourth	Excision of pouch
Monsarrat	F. 58	Second	Excision of perforated pouch
Huddy	F. 27	Second	Excision of gangrenous pouch
Basch	F. 36	Second	Excision of pouch and gastrojejunostomy
Schmidt and Ohly	F. 28	Several diverticula	Gastrojejunostomy with pyloric closure
Larimore and Graham	F. 63	Third	Pouch invaginated
Spriggs and Marxer	M. 54	Several diverticula Second and third	Gastrojejunostomy
Stiles (Spriggs and Marxer) ..	—	Second	Excision of pouch
McQuay	F. 34	Second	Excision of pouch
McQuay	F. 40	Second	Excision of pouch
McQuay	F. 78	Second and third	Excision of both sacs

a gastrojejunostomy was performed at the same time. On one occasion the diverticulum was inverted into the duodenum, with death from general peritonitis shortly afterwards. In four cases the pouches were left alone : in two of them a gastrojejunostomy was done ; in the other two this was combined with pyloric exclusion, and both the patients died.

The chief difficulty in excising a diverticulum is locating it at the operation, even after this has been done accurately by the X rays, and several failures have been recorded. This difficulty should hardly arise in those that lie ventral to the pancreas, but it may be a very real one in the case of a pouch either dorsal to, or buried in, that gland. Spriggs suggests that the mouth of the diverticulum can usually be found with a finger invaginating the bowel wall opposite to it. Maclean, who was the first to excise one of these buried pouches in 1922, had already opened the duodenum to exclude the possibility of a stone in the lower end of the common duct—the woman had had a previous cholecystectomy for gall-stones and the pancreas was so hard that the duct could not be palpated at all—and was able to find the orifice of the pouch with his finger, and, keeping it there, to dissect out the diverticulum and remove it, after invaginating it into the bowel lumen. This was the only instance of a transduodenal excision of a sac until last year, when McQuay reported the employment of the same method.

In certain cases a localized induration of the pancreas has been a clue to the situation of a pouch buried in its substance. Maclean's method of reaching a peri-Vaterine diverticulum is by mobilizing the descending duodenum and the head of the pancreas. In the case of pouches arising from the third and fourth parts of the duodenum and lying in or dorsal to the pancreas, he turns up the transverse colon and great omentum, thus exposing the third part of the duodenum below the attachment of the transverse mesocolon. The descending layer of the latter is incised along the lower duodenal border opposite the supposed situation of the pouch, the right colic artery being avoided, while the superior mesenteric vessels are retracted to the left. The duodenum can then be turned up enough to expose the pouch, which is dissected out ; its neck is ligated and the hole in the duodenal wall is repaired.

II. SECONDARY DIVERTICULITIS.

As was pointed out above, these 'secondary' diverticula, as I have called them, are entirely different from anything that has been considered so far. This group will be distinguished from the 'primary' variety by the fact that they are found, with very few exceptions, in the first part of the duodenum, and by their having, as a rule, a complete muscular coat. They have been found less frequently than these others both post mortem and in X-ray examinations (*see Table IV*). For purposes of description, the old division into pulsion and traction diverticula may be employed.

1. **Pulsion Diverticula.**—Pulsion pouches are caused occasionally directly, or more frequently indirectly, by chronic ulceration of the bowel.

a. Diverticula Directly Due to an Ulcer.—Lefèvre and Jonchères found at operation an ulcer on the lower posterior border of the first part of the duodenum, which encircled the orifice of a diverticulum. After a pylorectomy

the pouch was found to have all its muscular coats present, with ulceration of the mucous membrane. Wilkie has recorded three cases of 'ulcer diverticulum', as he called it. In each of these, an inch from the pylorus, in the upper wall of the duodenum, a sac was found formed by dense fibrous adhesions, the bowel wall having been destroyed by ulceration. Here, too, may be mentioned the case recorded by Morrison and Feldman, who found in the mouth of such a diverticulum a small indurated mass with metastases in the neighbouring glands and in the liver. The autopsy showed a primary carcinoma of the diverticulum, which is the only instance of this occurring in the literature.

b. Diverticula Indirectly Due to an Ulcer.—A commoner occurrence is to find diverticula of the first part of the duodenum in close proximity to ulcers or their scars. Baensch has suggested that 'recessus duodeni' would be a more fitting term for these pouches. In these all the coats of the bowel are present, except in one case recorded by Ritchie and MacWhorter, who found at operation a definite duodenal ulcer almost symmetrically opposed to the opening of a diverticulum. This sac looked like a 'gas hernia', with a thin wall, which led down to a small opening in the muscularis.

Usually these out-pouchings occur opposite ulcer scars. Nagel explains this by the fact that ulcers occur commonly along the superior border of the duodenum. If there is subsequent scarring, shortening of this border must ensue, while the corresponding lower border will become redundant and favourable for the formation of recesses. Occasionally, however, they are proximal to an ulcer scar. In Jach's case an obliquely placed cicatrix was found 2 cm. from the pylorus, while between this and the pylorus was the orifice of a pouch large enough to admit the finger-tip. Carman attributes such diverticula to prolonged muscular spasm at the ulcer level. A further probable factor may be changes in the bowel wall in the neighbourhood of the ulcer. Roth found, for example, fatty degeneration of all the coats in the descending duodenum, with a cicatrized ulcer in its first portion.

c. Diverticula Associated with Gastric Ulcers.—In another small group must be placed diverticula in this first part of the bowel associated with gastric ulcers. Chaton has published three cases of this combination, found in pylorectomies; I have found two more in the literature (Murchison and Falconer). In Falconer's case an hour-glass stomach was found post mortem with a diverticulum along the greater curvature of the pyloric canal; a second diverticulum occurred just beyond the pylorus. There was a cicatrix in the upper border of the pyloric portion of the stomach.

2. Traction Diverticula.—While such pathological curiosities as a myoma or an angeioma in the duodenal wall have been said to cause pockets (Hansemann), the common cause of this class of pouch is the pull of adherent viscera in the neighbourhood. For example, Huddy found a gastric ulcer on the lesser curvature which was adherent to a pouch of the first part of the duodenum. Out of nineteen secondary diverticula described by Nagel, three were due to gall-bladder adhesions, while Hunt and Herbst discovered at an operation a fistulous connection between the gall-bladder and a secondary duodenal pouch. Gall-stones had entered the latter, but could not escape into the bowel through its narrow stoma. Harley's case, published in 1857 and

noted above, should probably belong to this category. Again, Nagel has seen two cases where duodenal diverticula were caused by the traction of appendicitis adhesions. All these traction pouches are found as a rule in the first or in the upper portion of the second part of the duodenum, but Wierig has seen them in the third part, as the result of gall-bladder disease.

As the pathology of these secondary diverticula is that of the disease that causes them, they do not, of themselves, give rise to symptoms, and in most cases they have been treated by operations designed to cure the primary trouble. I have found records of 26 instances where pouches secondary to duodenal ulcers have been operated upon. Of these, 12 were removed by pylorectomy; 1 was excised and a gastrojejunostomy was performed; 2 were included in a pyloroplasty; 6 were inverted, and in 3 of these a gastrojejunostomy was done as well; while in the other 5 cases a gastrojejunostomy was alone performed and the pouch was left untouched.

III. DIVERTICULA ASSOCIATED WITH THE MAJOR PAPILLA.

To complete the subject a third variety of pouch must be briefly considered. Under this heading are described two groups of diverticula which differ considerably from each other both in their origin and in their clinical significance.

1. The first of these is caused by the dilatation of Vater's ampulla. According to Baensch this may be a congenital condition, a papilla not being formed, or it may be acquired from an impacted gall-stone in this situation, or is possibly the result of a duodenitis with a complicating cholangitis. The first diverticulum ever described (Chomel) was apparently a dilated ampulla containing gall-stones. This condition, however it is caused, is, as has been already pointed out, important pathologically. Case found it in 15 instances, and in half of these there was clinical evidence of chronic pancreatitis.

2. On the other hand, the major papilla may lie at the bottom of a shallow duodenal diverticulum. This is in many cases a congenital condition, and may be taken as persisting evidence of the original hepatic outgrowth from the bowel. Baldwin writes that in 60 per cent of the adult duodena he examined, the biliary papilla lay at the bottom of a distinct depression. At the same time traction of the common bile-duct, combined with a certain degree of enteroptosis, might well produce a similar condition. Baldwin found an instance of such a pouch post mortem. In a woman, age 61, there was a small shallow pouch 0·2 cm. deep, in the depth of which lay the major papilla. This latter variety of diverticulum cannot, I think, be of any clinical significance whatever.

CONCLUSIONS.

1. The classification of diverticula here suggested is: (*a*) Primary pouches, found without any apparent cause, and confined to the second, third, and fourth parts of the duodenum; (*b*) Secondary pouches, which are always due either to chronic duodenal ulcers or to the traction of adhesions, and only occur in the first part; (*c*) Vaterine pouches, associated with the biliary papilla.

2. Primary pouches are probably of congenital origin, although there is no certain proof of this. It is suggested that, at some time during the later six months of fœtal life, an exaggerated downgrowth of Lieberkühn's crypts may reach lacunæ in the muscular coat, where this is pierced by the blood-vessels: the perivascular sheaths of the latter will then provide an easy path for any further extension. From such weak spots pulsion diverticula may arise during adult life.

3. The great majority of these pouches do not cause any trouble, and, since their demonstration by the X rays, their significance has probably been exaggerated.

I should like to thank Professor Arthur Thomson for a great deal of helpful advice, Dr. H. M. Carleton for kindly examining some slides for me, and Mr. W. Chesterman for much assistance and for the production of the photographs.

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A LESION COMMON TO BREAST AND PROSTATE GLANDS.

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SURGEON TO KING'S COLLEGE HOSPITAL, LONDON;
AND R. S. WALE.

The following communication is based upon a routine examination of eighty consecutive prostate glands removed for the relief of the ordinary symptoms of prostatic obstruction. It is not proposed to describe in detail all these specimens; all that is intended is to call attention to a connected sequence of pathological events in the prostate that corresponds to a similar sequence of events that occurs in a certain disease of breasts.

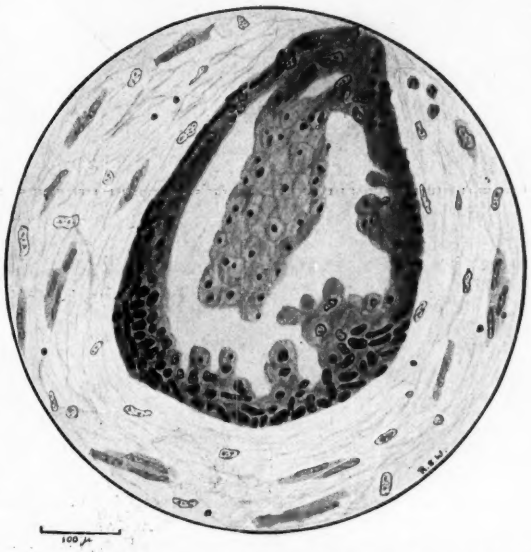

Fig. 365.—An oblique microscopical section of a prostatic duct under high power. The epithelium is undergoing a desquamative hyperplasia. The epithelial cells lining the duct are becoming elongated and are multiplying and are finally being shed. The colostrum-like cells which have collected in the centre of the distended duct are to be seen in all stages of formation. (× 100.)

The disease in the breast has been described by Brodie, Schimmelbusch, Reclus, and many text-books, and in the minds of men it has become established under the misleading term of 'chronic cystic mastitis'. Several authors pick out certain parts of the lesion and describe them while omitting others. Few have connected all its manifestations in one compact entity.

In the breast the disease can be seen passing from one stage into another with a complete consistency when all the stages of the lesion occur. The stages in the breast are as follows: First there is a cystiphorous desquamative epithelial hyperplasia that ends in shedding dead cells and the formation of large and small cysts; the process may end here. Secondly, there is a transformation of the cystiphorous desquamation into epithelial neoplasia; the cells are all viable and capable of multiplication: this condition may remain benign; papillomatous formations are a marked feature of this stage. Thirdly, the epithelial neoplasia may pass on to carcinoma. This is the mode of origin and course of events in 20 to 25 per cent of all breast carcinomata. These events begin in three

successive decades of life. The stage of cystiphorous desquamative hyperplasia begins between the late twenties and early thirties. The stage of benign epithelial neoplasia begins in the late thirties and early forties, and the stage of carcinoma begins in the late forties and early fifties. When the disease ends in carcinoma all stages are visible in the lesion.

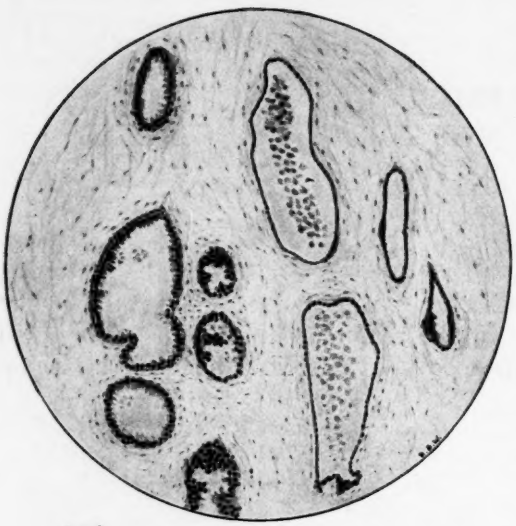

FIG. 366.—A more advanced stage of the process seen in *Fig.* 365. Two distended ducts are seen cut longitudinally which contain a collection of shed colostrum-like cells. (× 40.)

We have noticed indications of the same course of events occurring among the specimens examined of the prostate. At last we have discovered one in which all the stages are exhibited in the same gland. It was also the only carcinoma detected in the series. The carcinoma it contained was unsuspected at the time of its removal, and was discovered during the ordinary routine examination of whole microscopical sections. The patient was 67 years of age and complained only of the usual symptoms of prostatic obstruction with the usual protracted onset.

Fig. 365 is a drawing of a duct of this prostate under high power; the

FIG. 367.—Whole microscopic section of part of a prostate that was removed in a multicystic state. The epithelial change was arrested at the cystiphorous stage. There is no sign of epithelial neoplasia in the gland. (× 1½.)

colostrum-like corpuscles are seen in all stages of formation, before and after having been shed. This represents the stage of cystiphorous desquamative epithelial hyperplasia. *Fig.* 366 shows their accumulation within the duct. The cells bear an extraordinary resemblance to the colostrum-like cells seen in the same disease in the breast. Like the disease in the breast it may end at this stage and remain for long periods as a multicystic prostate gland (*Fig.* 367). These cysts are usually filled by straw-coloured or greenish fluid. *Fig.* 368 shows the transformation occurring from the desquamative stage into benign epithelial neoplasia, a condition that is better seen and more complete in *Fig.* 369. In this stage uniradicular and multiradicular papillomata may form (*Fig.* 370) as well as the sessile collections of neoplastic

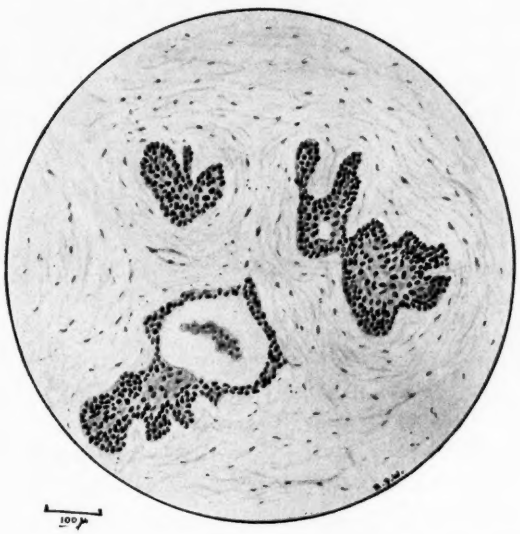

FIG. 368.—The cystiphorous desquamation is in the process of transformation into the stage of epithelial neoplasia in which all the epithelial cells are confined within normal boundaries and are benign in morphological appearance. (× 70.)

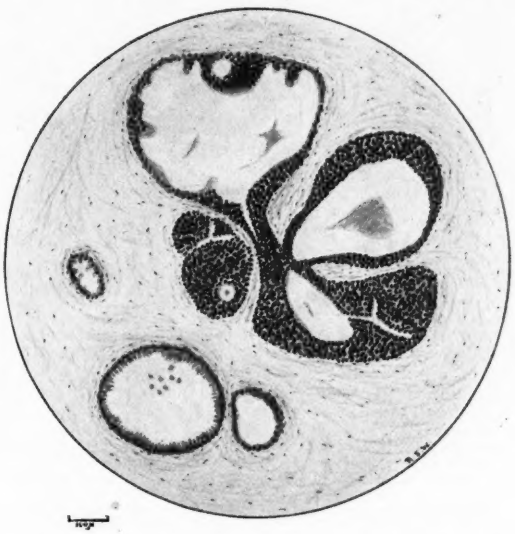

FIG. 369.—The same conditions are seen as in *Fig.* 368. The epithelial neoplasia has become more marked and in greater amount. All the epithelial cells are contained in normal but distended boundaries. It is sessile in parts and does not contain fibrous connective tissue element. Cystiphorous desquamation is still in being. (× 50.)

epithelial cells among which there is no connective-tissue element (*Fig.* 369). *Fig.* 371 is a reproduction of part of the carcinomatous area.

Further investigation is essential in order to determine whether the decades of life in which the separate stages of the disease begin in the prostate correspond to those of the breast. The lesion in the prostate, as in the breast, is not related to the formation of fibro-adenoma; it is a lesion affecting the glandular epithelium only, nor are there any signs of an etiological relationship to inflammation. While examining these sections in ignorance of the gland under observation—whether prostate or breast—the observer would have great difficulty in coming to a correct decision as to the source of the material.

Horst Oertel has recorded resemblances between mammary and prostatic changes. He considers them all to be merely senile in nature. We

regard the occurrences of epithelial hyperplasia and neoplasia as pathological changes. The initial stage in the breast, viz., the cystiphorous desquamative stage, begins in the decade between the late twenties and early thirties

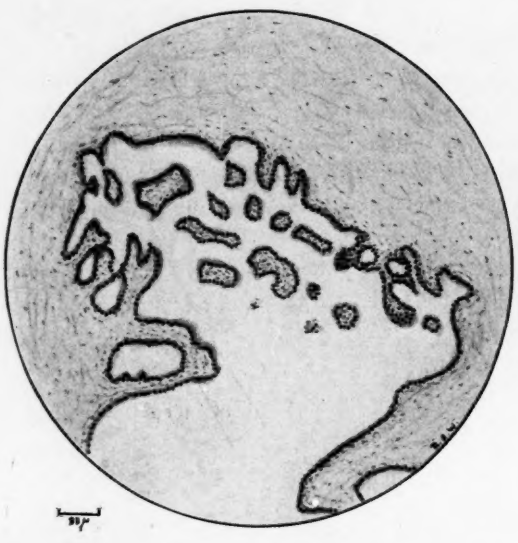

FIG. 370.—The epithelial neoplasia in this prostate gland is papillomatous in formation and the tumour is multiradicular. Many of the tips of its branches are seen in the centre of the cyst. (× 50.)

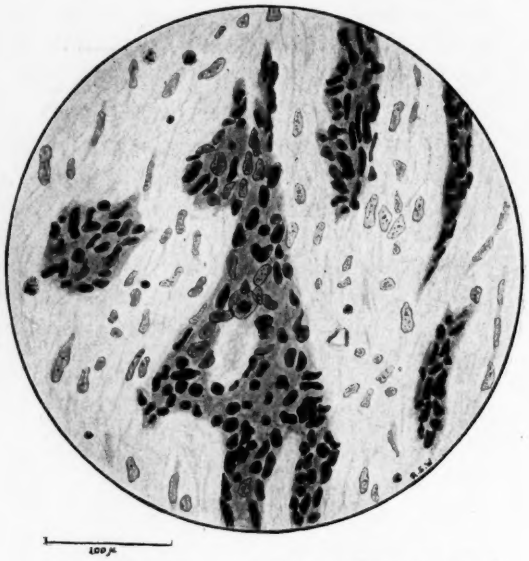

FIG. 371.—The epithelial neoplasia has passed into carcinoma. Collections of epithelial cells are seen among fibres of connective tissue. (× 160.)

and is too early to be regarded as a senile change. The prostate should be an active gland long after the period of any of the changes we have described above if its secretion be essential for the elaboration of semen.

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THE SURGERY OF UNDESCENDED TESTIS.*

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Over twenty years ago Stansfield Collier demonstrated to me a simple method of placing the undescended testis in the scrotum without detriment to its future existence or development. This operation, depending for its success on a recognition of elementary anatomical facts, I have practised systematically since that time; and I have only refrained from recording the results in the past in the hope that some evidence as to the reproductive functions of such testes would be forthcoming with the lapse of time. It is particularly disappointing to find that no case could be traced beyond ten years; but a study of the results obtained over that period would appear to be worthy of record. Another reason for placing on record the study of this comparatively small series of cases is the pessimism which, based on the failure of surgery in the past, seems to be largely prevalent at the present time.

The failure of orchidopexy, as originally practised, led to the advocacy of two alternatives: (1) Abdominal extraperitoneal replacement; and (2) Removal of the imperfectly descended organ. I have never practised the former method since Stansfield Collier demonstrated to me that the large majority of undescended testes should be amenable to scrotal replacement; while 'removal' probably has few advocates at the present time.

Both procedures were apparently based on the belief in the liability to injury of the retained testis, and on the supposed relationship of the cryptorchid to neoplasm of the testis. Russell Howard,[1] reviewing a series of 57 cases, concluded that there is an increased liability to neoplasm in the undescended testis; and he quotes Jonathan Hutchinson, jun., in support. This conclusion is disputed by McAdam Eccles. It is probable that the balance of opinion at the present time would support the view that the imperfectly descended testis is more liable to injury, but *not* more liable to malignant disease, than the normally placed organ. Similarly, the rarity of malignant change in the abdominal testis (I have encountered only one instance, which was operated upon by my colleague Mr. Sinclair) negatives the suggestion that this situation is a predisposing factor.

It will probably be conceded, therefore, that there is little to recommend either 'removal' or abdominal replacement of the undescended testis if scrotal replacement can be achieved with a reasonable prospect of satisfactory development and function. Stansfield Collier's method offers such a prospect; and my own results have encouraged me to outline the steps of the operation, and the summary of the lessons to be learned, in the hope that a brighter

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outlook on the surgery of this condition may result. In more recent years the results of a similar procedure, reported by Southam and Cooper,[2] are equally encouraging.

THE OPERATION.

The first anatomical point to be noted is that the spermatic arteries, arising from the aorta, do not pursue a straight course to the inguinal canal. The course of the spermatic veins is equally indirect. Stansfield Collier, by fixing the testis with the fingers and exercising gentle tension upon the cord, endeavoured to mobilize the spermatic vessels towards the mid-line with a finger, gently worked upwards into the abdomen through the internal ring. He demonstrated that very material length to the cord could thus be obtained and many testes brought into the scrotum without undue tension.

The mobilization of the spermatic vessels from the peritoneum cannot in actual fact be effected by any such manipulation, for not only does the spermatic vein receive tributaries from the ureter, but, on the left side, from the iliac and pelvic colon.[3] Further, the close adherence of the ureter to the parietal peritoneum is one of the first points of importance in the surgery of the large bowel, and the adherence of the spermatic vessels to the peritoneum is equally marked. It is therefore impossible, by any blind manipulation, so to mobilize them by separation. If, however, the peritoneum, together with the adherent vessels and the large intestine, be extensively mobilized, the degree of lengthening of the cord obtainable will depend on the elasticity of the peritoneum, and therefore to a large extent on the age of the patient.

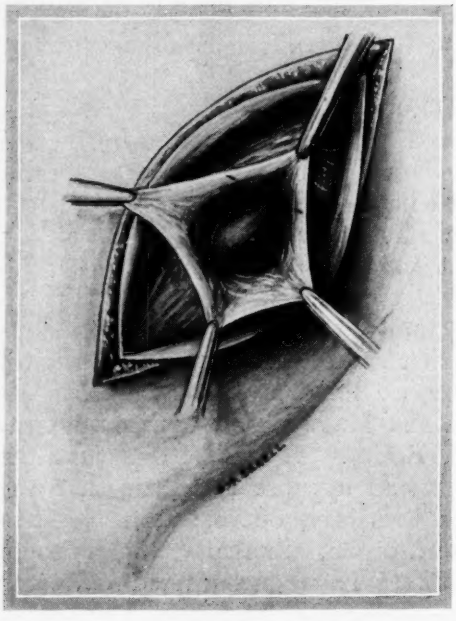

FIG. 372.—Testis lying in the open sac.

The success of the operation of orchidopexy therefore depends largely on two factors: (1) *Adequate mobilization of the peritoneum and attached spermatic vessels*—the object being to make the vessels take a straight course to the scrotum; and (2) *The age at which operation is undertaken.* The younger the subject, the more elastic is the peritoneum. Against this must be considered the increased vulnerability of the vessels in the young, and consequently the risk of damage to the blood-supply of the testes.

The steps of the operation are simple. The incision is that employed for inguinal hernia. The external oblique is divided to a point just above the internal ring.

If the testis is lying in a patent processus vaginalis, as is most commonly the case (*Fig.* 372), it is brought outside the everted sac, and gentle traction

is exerted on it to render the cord a little taut. The sac is split to the internal ring (*Fig.* 372), and at this point it can be easily separated with great gentleness from the cord and vas, and ligatured. The separation should extend well into the abdominal cavity. The point to choose for this separation is at or above the point where the vas leaves the vessels and turns inwards (*Fig.* 373). As a rule it is useless to attempt such a separation below this point; for the delayed development of cord, vas, and epididymis, together with the delayed descent of the testis, is associated with the defective development of the peritoneum. This is thin, friable, and adherent. Above the deflection of the vas, however, separation is always possible, and can be extended well into the abdominal cavity (*Fig.* 373). If the testis lies in a normal tunica vaginalis, this may be opened and the testis brought outside, the sac being evaginated. A search is then made for a patent funicular process or definite hernial sac, either being appropriately dealt with.

FIG. 373.—Separation of neck of sac at the point where the vas leaves the cord to turn inwards.

In all cases the gubernaculum is divided between ligatures so that the testis is completely free. Gentle traction is now exerted on the testis while

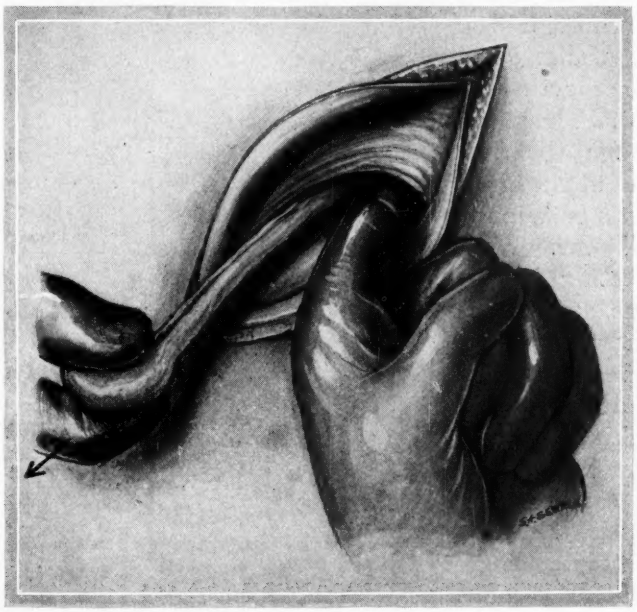

FIG. 374.—Mobilization of the peritoneum.

the forefinger is gently worked up into the abdominal cavity, mobilizing the peritoneum anteriorly, internally, and downwards, until the vessels can be

felt projecting anteriorly into the abdominal cavity and nearer to the mid-line (*Fig.* 374). This manœuvre can be continued as far up and as extensively as is necessary to bring the testis easily into the scrotum. In some of the worst cases the connective tissue of the cord may be completely divided so that only the vessels and the vas remain intact (Southam and Cooper[2]). This, in my experience, is rarely necessary and usually inadvisable.

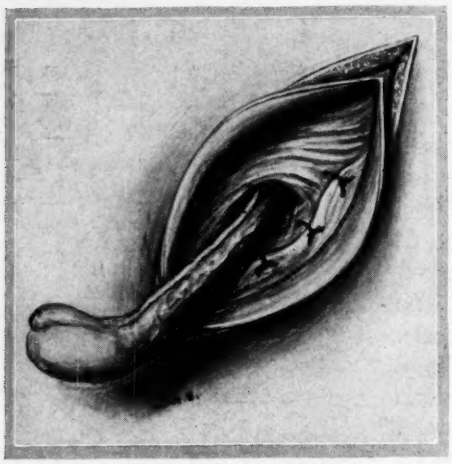

FIG. 375.—Cord brought through stab-wound in conjoined tendon, and suture of Poupart's ligament to to the tendon.

In some instances the testis and cord have been brought into the scrotum through a stab-wound in the conjoined tendon before suturing this tendon to Poupart's ligament (*Fig.* 375).

The Fixation of the Testis in the Scrotum.—With the forefinger a passage is forced well into the scrotum to make an effective bed. While tension is so exerted on the skin of the scrotum a straight needle threaded with salmon gut is passed from without through the scrotal bed into the inguinal canal, the finger acting as guide (*Fig.* 376). The stitch is passed through the firm tunica albuginea at the lower pole of the testis between it and the epididymis. With a pair of dissecting forceps the skin of the scrotum is picked up at the point where the stitch entered, and (the finger again acting as a guide) the skin of the scrotum is invaginated into the inguinal canal. The needle is passed outwards again at this point. These trivial details seem perhaps to be unduly laboured; but it is most important that the ingoing and outgoing stitch shall follow accurately

FIG. 376.—Preparation of scrotal bed by the finger, guided by which the needle is shown passing upwards.

the artificial tunnel into the scrotum. This ensures that no areolar tissue barriers shall prevent the easy descent of the testis into the scrotum or hamper its maintenance in that situation. The stitch is then passed through the inner side of the thigh, over a small roll of gauze (*Fig.* 377). Finally the suture of the external oblique and the skin completes the operation.

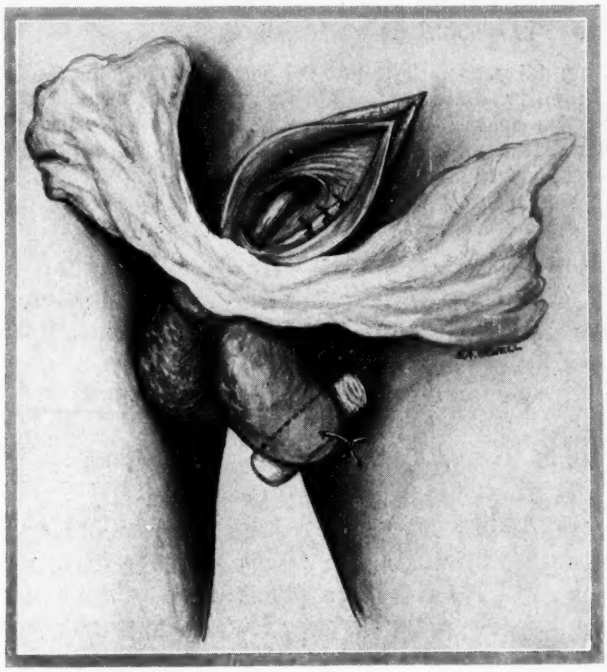

FIG. 377.—Fixation of testis in the scrotum by a suture which passes through the thigh.

Subsequent History.—There is always a considerable degree of swelling of testis and cord following the operation. The inguinal stitch is removed on the eighth or ninth day, and the stitch in the thigh remains in from ten to fourteen days. For a month or six weeks—sometimes longer—the swollen testis may often lie in the neck of the scrotum close to the pubis. As time goes on it slowly descends into the scrotum, and in favourable cases both testis and cord approach the normal. This is usually achieved in from five to six months.

I have been able to collect the notes of twenty-eight cases (thirty-three operations) in which the immediate results were satisfactory. In one instance the patient refused to come up for examination as he " was quite well ". In two further instances there has been no reply to repeated inquiries. The results of the remaining thirty operations have been ascertained after varying periods of over one and a half to ten years.

There are three types of cases in which the testis does not lie in the scrotum: (1) *Post-operative retained testis;* (2) *Mobile testis;* and (3) *' Undescended testis '.*

1. POST-OPERATIVE RETAINED TESTIS.

During the operation for hernia (especially in fat infants with 'mobile testes'), if care is not taken to ensure the presence of the testis in the scrotum before the final sutures are completed, it is not at all impossible for the testis to be caught up in the inguinal canal. It has fallen to my lot on several occasions to release and replace in the scrotum a testis retained by such an accident. One case is quoted as an instance.

E. A. J. W., age 25 years. The patient gave a history of radical cure of double inguinal hernia in early childhood. No note of any abnormality of the testis previously. After the operation the right testis was noticed by the parents to be absent from the scrotum. At the operation (over twenty years later) the testis was easily freed—without mobilization—and placed in the scrotum. It was normally developed and in normal relationship with the epididymis, though it was rather smaller than that on the left side.

There is no question that this was an example of accidental post-operative retention in the inguinal canal. But it is instructive as an instance of the possibility of a practically normal development of the testis in the inguinal canal—as judged by clinical examination.

2. MOBILE TESTIS.

So frequently is this condition mistaken for 'undescended testis' that no classification is complete without mention of it.

The cremasteric reflex is stimulated by exposure to cold, examination, bathing, etc. By this stimulus the testes retract—in some instances into the inguinal canal. Children with a pronounced reflex are very frequently presented as suffering from undescended testis, inguinal hernia, irreducible (and on occasion strangulated) hernia. On examination the testis is not in the scrotum, but can easily be replaced into its normal position with patient manipulation. The condition is physiological and requires no treatment. The frequency with which mistakes in diagnosis are made is sufficient apology for referring to this class of case.

In one practical respect, however, the mobile testis is important. Sometimes the stimulus of examination causes the retraction of the testis into the inguinal canal, where it presents a swelling which is evanescent and often leads to a diagnosis of hernia—a point to be remembered if mistakes are to be avoided.

3. UNDESCENDED TESTIS.

This short series of cases has demonstrated that there are two quite distinct types of undescended testis: (*I*) The testis lying in its own tunica vaginalis, either not associated with a hernia, or completely independent of an associated hernial sac; (*II*) The undescended testis lying in a patent processus vaginalis.

Type I.—The Undescended Testis Lying in its Own Tunica Vaginalis and Unconnected with a Hernial Sac.

There are seven cases of this type in the present series, embracing nine operations.

Case 1.—E. L., age 13½ years. The doctor at school noticed the right testis was undescended. On examination, the organ could just be brought to the neck of the scrotum. No hernia seen.

March, 1921.—Usual exposure. Patent funicular process, unconnected with the testis, transfixed and ligatured. Undescended testis found, mobilized in the usual manner, and brought through an opening in the conjoined tendon into the scrotum. Suture to the thigh and completion of operation as usual.

March, 1929.—Right testis perfect. Size, consistence, elasticity, and elements of the cord in every respect identical with the left side.

Case 2.—J. W. N., age 9 years. Scrotum developed, but empty. Slight swelling in both inguinal canals on coughing. Rings a little large.

December, 1923.—Operation on right side. A well-developed testis was found, but no hernial sac. Usual mobilization and fixation.

September, 1925.—Operation on left side by another surgeon. Small sac isolated and removed. Testis, in inguinal canal, freed and brought 'easily' into the scrotum. Mobilization was not practised.

1928.—Result: right side (mobilization)—perfect; left side (no mobilization)—poor (*Fig.* 378).

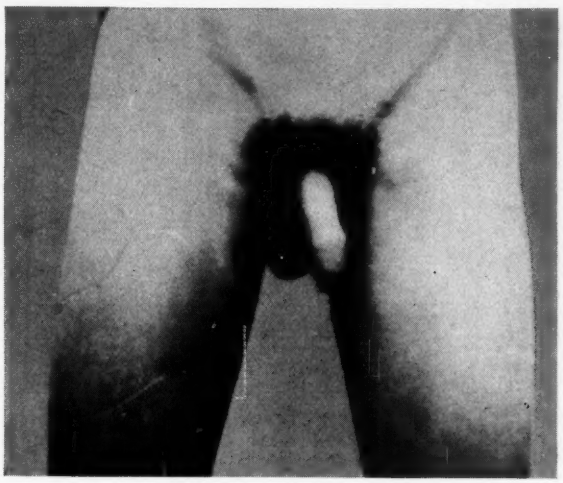

FIG. 378.—*Case* 2.

Case 3.—G. M., age 9 years. Complained of right undescended testis. On examination there was no evidence of hernia. The right testis could not be felt or seen; the left testis was at the neck of the scrotum.

June, 1924.—Operation on right side—usual exposure. Small potential sac (unconnected with the testis) separated and ligatured. Usual mobilization and fixation of the testis.

May, 1926.—Right testis satisfactorily in scrotum. Left testis still at the neck of the scrotum.

September, 1927.—Left orchidopexy in usual manner.

June, 1928.—Final result: good both right and left. Left testis is a little lower than the right.

Case 4.—R. S., age 5 years. Complained of right undescended testis. On examination the right testis was in the inguinal canal. No hernia was detected.

November, 1925.—Operation on right side disclosed a small sac. The testis was easily replaced and fixed in the scrotum in the usual way, after full mobilization.

February, 1929.—Right testis is of normal size and consistence. Comparison of right and left sides shows the cord, epididymis, and testis approximately identical except that the right is a trifle smaller than the left.

Case 5.—D. B., age 8 years. Complained of double undescended testis. On examination testes not palpable in scrotum or inguinal canals.

December, 1927.—Operation on right side. Usual exposure. Very small sac isolated and ligatured. Usual mobilization and fixation of testis in scrotum.

1928.—Excellent result. Left side not yet operated on.

Case 6.—M. F., age 10 years. Double undescended testis. Right side can be brought down lower than the left. Impulse right and left on coughing.

Feb. 9, 1928.—Operation on right side. Testis found inside internal abdominal ring. Small funicular process freed and ligatured. Usual mobilization enabled the testis to be brought into the scrotum *with considerable tension*. Right leg kept flexed to about 30° and gradually straightened from day to day.

June, 1929.—Testis in scrotum; size normal; elasticity good. Apparently normal testis for age.

Case 7.—G. M., age 13 years. Complained of right undescended testis. Testis could be grought just to the brim of the pelvis. Left side normal.

May 8, 1928.—Operation on right side—usual exposure. Testis lying in a normal tunica vaginalis. No hernial sac found. Extensive mobilization rendered the testis *replaceable in the scrotum with considerable difficulty*. Thigh flexed after usual fixation and gradually straightened during the next few days.

October, 1928.—The testis was thickened and hard and lay just under the pelvic brim.

June, 1929.—The testis lay at the bottom of the scrotum. The elements of the cord were easily distinguishable; consistence and sensation were apparently normal.

Type II.—The Undescended Testis Lying in a Congenital Hernial Sac.

This is quite the commonest variety of undescended testis, the series embracing seventeen cases and twenty-two operations.

Case 8.—L. M., age 9 years. Complained of double undescended testis. No hernia seen.

Oct. 16, 1919.—Usual exposure. Testis lying in patent processus vaginalis. Sac found and ligatured at internal ring. Usual mobilization and suture to thigh.

February, 1929.—Right testis lying free in the *fundus* of the scrotum and as fully developed as the left. Left testis lies at the *neck* of the scrotum and is associated with a large hernia. Consistence, sensation, and sexual development appear normal (age 19 years). Elements of cord are distinguishable and appear normal.

Case 9.—R. J. H., age 6 years, 10 months. Complained of double undescended testis. Mother noticed scrotum undeveloped at birth and testes not descended.

Jan. 8, 1920.—Right hernial incision. Small testis in patent processus vaginalis. Usual isolation and ligature of sac; mobilization of testis and cord, and scrotal fixation.

1928.—Right testis normal and developing according to age (15 years). Left testis not in scrotum: never operated on. Sexual development appears normal.

Case 10.—C. D., age 6 years, 4 months. Only child, had suffered from mumps. Complained of right undescended testis and hernia. On examination the right testis was found to be in the inguinal canal.

February, 1921.—The notes contain no comment on the condition of the testis, but the usual operation was performed.

June, 1928.—From a clinical examination the testis (lying on the pelvic brim) appears to be completely atrophied.

Case 11.—G. H. P., age 8½ years. Complained of double inguinal hernia and undescended testes. On examination the right hernia and undescended testis were felt. Left testis not palpable.

November, 1921.—Usual operation.

1928.—Apparently a normal well-developed testis in the scrotum on the right side. The left testis (not operated upon) is small and undeveloped, and lies just below the brim of the pelvis; there is a hydrocele below it. Sexual development appears to be normal.

Case 12.—N. J. B., age 6 years. Complained of right inguinal hernia and double undescended testes. The child's mother noticed a lump on right side, reducible, but growing larger. The doctor noticed double undescended testes. Examination showed double undescended testes and right inguinal hernia.

July, 1922—First operation: usual procedure on right side. Second operation: left side (by another surgeon). No mobilization. Testis small and lying in processus vaginalis. Cord could not be separated from sac; sac closed; testis fixed to thigh.

1928.—Right side (mobilization)—good result; left side (no mobilization)—failure (*Fig.* 379.)

FIG. 379.—*Case* 12.

Case 13.—J. D., age 11 years. Only child. Complained of right inguinal hernia and undescended testis. Left side normal. On examination the right testis was at the external ring and could only be brought to the pelvic brim.

January, 1924.—Testis lying in patent processus vaginalis. Usual procedure.

June, 1928.—Testis *fairly* developed—not so fully developed as left. Testicular sensation equal on both sides. Right less developed than left.

Case 14.—D. P., age 8 years. Complained of double undescended testes.

December, 1924.—Usual operation on right side. Immediate result satisfactory.

June, 1926.—Left side operated upon as the right was so satisfactory. Usual procedure.

June, 1928.—Right side—result excellent; left side—testis undeveloped.

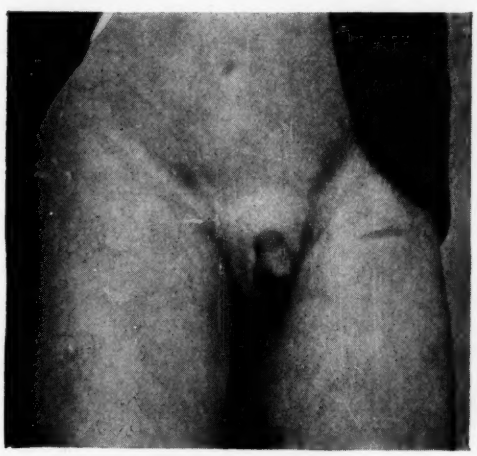

FIG. 380.—*Case* 16.

Case 15.—W. S., age 11 years. Complained of undescended testis.

March, 1925.—Usual operation. Testis found almost 'intra-abdominal'.

June, 1928.—No atrophy. Left testis smaller than right; otherwise appearances normal on examination. The testis seems to be developing well, though it is not so low in the scrotum as the right.

Case 16.—J. R., age 7 years. Complained of double undescended testes. No hernia seen.

November, 1925.—Usual operation on right side.

October, 1927.—Left orchidopexy by another surgeon.

June, 1928.—Right side, normal and in good position. Left side (imperfect mobilization), testis a little hard and lying high (*Fig.* 380).

Case 17.—D. P., age 6 years. Complained of double undescended testes. Both could be felt in the inguinal canals.

November, 1925.—Usual procedure on right side. Immediate result satisfactory.
1928.—Testis cannot be felt. Probably complete atrophy. No further operation.

Case 18.—A. D., age 2½ years. Complained of right inguinal hernia; noticed at 7 weeks and increasing in size. Examination showed right inguinal hernia and undescended testis. Testis palpable high in the inguinal canal.

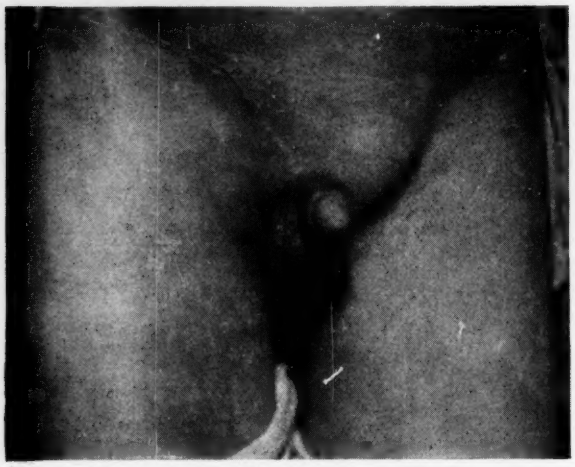

FIG. 381.—*Case* 19.

March, 1926.—Usual operation on right side. Testis lying on internal oblique. Testis replaced in scrotum *without tension*.

May, 1928.—Result poor. Small testis and epididymis palpable. Probably delayed development (cf. age) and associated atrophy.

Case 19.—D. H., 9 years. Complained of double undescended testes. On examination small atrophic testes were felt in the inguinal canals. No hernia seen.

April, 1926.—Operation on right side by the usual method. Testis found in thin-walled sac Replacement in the scrotum *without tension*.

June, 1928.—Result good (*Fig.* 381).

July, 1928.—Left testis *not* felt. Operation on left side disclosed the testis in hernial sac. Usual procedure.

January, 1929.—Both sides very satisfactory (*Fig.* 382).

Case 20.—C. B., age 8 years, 3 months. Operation at another hospital for right inguinal hernia when 19 months old. On examination the testis was misplaced and painful; child vomited at times. Testis could be felt at the external ring.

March, 1926.—Operation on right side. Testis found bound to the external ring by fibrous adhesions. It could not be brought into the scrotum until after *extensive mobilization*. Then replacement was carried out *without tension*.

1928.—Fair result. Some testicular atrophy.

FIG. 382.—*Case* 19.

Case 21.—N. G., age 6 years, 5 months. Complained of right undescended testis. Left side normal. On examination the right testis was found lying below the external ring above the pubis.

September, 1926.—Operation on right side. Testis lying in hernial sac. Usual procedure. Testis easily replaced in scrotum after mobilization.

June, 1928.—Result perfect (*Fig.* 383).

Case 22.—C. W., age 8 years, 4 months. Complained of double undescended testes. Examination showed the right testis to be mobile; left testis undescended. Operation on left side disclosed a very undeveloped testis in a patent processus vaginalis. The vessels were very small and the vas no larger than a thread. Necessary mobilization was extensive, and replacement was associated with some tension. Prognosis was considered doubtful.

February, 1929.—Atrophy.

Case 23.—R. S. T., age 11 years, 5 months. Complained of double undescended testes. On examination neither testis could be definitely felt.

July, 1928.—Operation on right side. Testis very high (almost intra-abdominal) in patent processus vaginalis. Usual operation, and the thigh flexed as there was some tension. Thigh straightened gradually in a few days. Prognosis guarded.

September, 1928.—Right side so satisfactory that operation was undertaken on the left side. Extensive mobilization caused a peritoneal tear which had to be sutured. Testis sutured in position with considerable difficulty.

FIG. 383. *Case* 21.

1929.—Right side: shape, elasticity, and consistence normal. Elements of the cord distinct, though slight thickening is left. Left side: testis is still a little high, and a little more thickening of the cord is detected than on the right side. Otherwise both results are good.

Case 24.—W. H. F., age 6½ years. Complained of a lump in the right groin.

1926.—Operation for right hernia by the house surgeon. Testis found small and atrophied. Radical cure of hernia; testis freed and brought into the scrotum (with difficulty) and fixed to the thigh in the usual manner.

July, 1928.—Admitted for undescended testis which could be felt at the external ring. Operation (kindly performed for me by Mr. Denis Browne): dense adhesions held the testis in the inguinal canal. About an inch of the original silkworm-gut suture *in situ* was removed. After the usual mobilization the testis could easily be secured in the scrotum.

1929.—Good result. Hardly any difference detected between the two sides.

DISCUSSION.

In estimating the results of operation, not only is the position of the testis in the scrotum taken into consideration, but due weight is given to the size and consistence of the testis, its relationship to the epididymis, the elements of the cord, and (when possible to estimate) testicular sensation. In this small series of twenty-four cases there were thirty-one operations. The end-results from one to ten years later are as follows:—

Perfect results	..	20	=	about 66 per cent
Fair results	..	3	=	„ 10 „ „
Poor results	..	5	=	„ 16 „ „
Atrophy ..	..	3	=	„ 10 „ „

Perfect Results.—It is significant that, of the twenty perfect results, one case was operated upon for the second time. On the first occasion the

operator did not practise peritoneal mobilization, and failure resulted; at the second operation success followed adequate mobilization. This case showed also that without mobilization atrophy may not necessarily result; but the testis may ascend again into the inguinal canal—in this instance the salmon-gut fixation suture was drawn up with the testis and was removed at the second operation.

Fair Results.—By this is meant a normal testis and cord which has either not developed to a size equal to the normal, or an organ which, though apparently normal, does not lie so low in the fundus of the scrotum as on the unaffected side. In this group there were two boys operated on at 11 *years old*; and in the third instance a second operation was undertaken after initial failure due to a neglect of the *principle of mobilization.*

Poor Results.—In this group are included those testes which, though not atrophied, are small, imperfectly developed, and similar to their state before operation. Of these five cases, in three instances *mobilization was not practised*; of the other two, one was 10 years old and the other 2½.

Atrophy.—This occurred in three instances. In one the testis and cord were noted as diminutive and the vas is stated to have been no larger than a thread. It is noted that the prognosis was very doubtful in view of the very extensive mobilization necessary to bring the testis into the scrotum. It is possible that this is the one instance in the series (which would amount to about 3 per cent in all cases) when scrotal replacement was impossible and abdominal replacement indicated.

Two very important issues are raised by this preliminary analysis :—

1. **The Necessity of Adequate Mobilization.**—Excluding atrophy, there were eight instances of results which fell short of the normal in some respect. Of these eight cases mobilization was not practised in three, and one was a second operation undertaken to remedy failure from this omission. About one-third of the indifferent results and failures may be attributed to this cause.

2. **The Age at which Operation is Undertaken.**—Of the remaining four imperfect results, the age was over 10 years in three cases, and 2½ in one. The average age at which a perfect result was obtained is about 9 years. Though the figures are too small for statistical purposes, it would appear both from results and from operative experience that, mobilization being more difficult to achieve (owing to diminishing elasticity of the peritoneum) with increasing age, the prognosis becomes progressively worse with increasing years. This is shown by the following table :—

	Over 10 years	
Perfect results ..	35 per cent	
Fair results ..	100 ,, ,,	(excluding one secondary orchidopexy)
Poor results ..	66 ,, ,,	

While, therefore, the age of 9 years may be accepted as the limit of the most favourable time for operation, and since a perfect result can be obtained at the age of 5 years, attention must be drawn to the case operated on at 2½ years. This resulted in a very poorly developed organ. No doubt the manipulation necessary for scrotal replacement is too severe for the structures at this age. Accordingly the writer's experience has led to the conclusion that *the most favourable age for operation is from 5 to 9 years.*

Before passing on to a more detailed analysis of the lessons to be learned from this series, attention may well be called again to the first table of results above. Under the heading 'fair results' are included testes which are not far short of perfect, and which appear to be developing into normal organs. If, then, these two groups are taken together; and if the poor results and cases of atrophy are classed as failures; the following rough table may be accepted as generally indicating the proportion of successful results to be expected:—

Perfect .. 66 Fair .. 10	..	Satisfactory	=	76
Poor .. 16 Atrophy .. 10	..	Failure	=	26

Southam and Cooper[2] have in recent years practised a similar operation to the one described, based on the principles which guided Stansfield Collier. It is curious to note that they claim 72 per cent of successful results, and 28 per cent of failures. The close agreement of the figures is an additional confirmation of the desirability of operating on these cases.

Classification.—It will have been noticed that two types of undescended testis have been differentiated: *Type I*—When the testis, lying in a normal tunica vaginalis, is not a content of a patent processus vaginalis; and *Type II*—When the testis lies in a patent processus vaginalis. There is a marked difference in these two types, and though such a distinction may be difficult to establish clinically, its appreciation is of importance.

Type I.—Sir Arthur Keith[4] describes the development of the gubernaculum and its influence on the descent of the testis as follows:—

> In the fourth month the deep muscular layer of the abdominal wall, composed of the internal oblique and transversalis, buds inwards and expands the plica gubernatrix [which continues the common urogenital mesentery to the groin] with muscular and fibrous tissues. [This joins up and seizes the caudal pole of the testis]. The gubernaculum grows downwards as a solid fibromuscular mass, until it reaches the subcutaneous tissue which at that time completely fills the scrotum. Its attachment to the scrotum is slight and easily broken. The gubernaculum, as it grows through the abdominal wall, carries with it: (1) A process of peritoneum (the processus vaginalis); (2) The transversalis fascia (the infundibuliform fascia); (3) The internal oblique and transversalis muscles to form the cremaster; (4) The spermatic fascia from the external oblique; (5) The deep layer (Scarpa's) of the superficial fascia of the groin.
>
> It will thus be seen that the gubernaculum testis is an actively growing mass of fibromuscular tissue which, starting from the inner muscular layer of the abdominal parietes in the groin, invades first the plica gubernatrix and then the abdominal wall itself, every layer of which it carries as a prolongation within the scrotum. *It is an invading army of cells.* It draws with it into the scrotum the peritoneum in the iliac fossa, on which the testis is dragged like a log on a sledge.

It will be appreciated that Keith holds no brief for views which would assign to intra-abdominal pressure, and other equally doubtful agencies, a rôle in the process of descent of the testis. He regards the descent into the scrotum as an integral part of development.

> Arrest of descent is commonly a symptom of arrest of testicular development. On the other hand, the testicle may assume an *ectopic position.*
>
> *The gubernaculum ends in the scrotum principally, but bands of it pass to end in the root of the penis, in the groin and in the perineum. These bands, normally slight, may be big enough to influence the descent of the testicle.*

In this class it is to be noted that the scrotum is often developed though it is empty. Further, the testis is usually found to be well developed and in normal approximation to its epididymis. The development of a normal tunica vaginalis and the absence of a hernial sac complete the picture of a normally developed testis and cord such as is found in cases of 'ectopic testis'. It would appear, therefore, that in this class the failure of descent is not part of a general failure of development, but only a failure of the gubernaculum in its scrotal position, and a consequent shortening of the elements of the cord. In a word, the fourth position of the ectopic testis (all being due to a failure of the gubernaculum) is in the inguinal canal.

It is significant that in this series of seven cases (nine operations) 100 per cent were perfect results when mobilization was practised; the only poor result was where mobilization was omitted.

Finally, the average age at the time of operation was 10 years (as against the average 8½ in *Type II*); so that, in spite of the age disadvantage, the results were much better.

All the evidence supports the view that in *Type I* the failure of descent is due primarily to the failure of development of the gubernaculum, and therefore to the failure of its guidance of a perfectly developed testis into its normal situation. This is in marked contrast to the poor development usually found in *Type II*.

Development of the Testis in the Inguinal Canal.—This question arises out of the foregoing remarks. That the testis can grow and develop on apparently normal lines in the canal is shown by the case quoted on p. 628. Here the right testis was noted at the operation to be normal in every respect to eye and touch, and only slightly smaller than on the unaffected side. The satisfactory development in this group also would support such a view, though the development is not so complete as in the scrotal position. This is well shown by *Case* 11 in *Type II*. On the right side (operated on) an apparently normal testis resulted seven years later, while the left testis, which descended to the neck of the scrotum in this seven years, was small and undeveloped.

Prognosis.—The outlook may be regarded with confidence in this group provided mobilization is adequate. The only poor result was in one instance when mobilization was not practised; while on the other side, with adequate mobilization, a successful result followed operation.

Free division of the connective tissue of the cord is recommended by Southam and Cooper.[2] This in my experience is rarely called for—indeed, I prefer to have a little tension on the cord than carry out extensive manipulation at a young age, for such tension falls on connective tissues rather than on the slender vessels.

A successful result in this group is by no means to be regarded as easier of achievement than in *Type II*; the cord may be very short and replacement difficult even when the testis is well developed. In two instances the testis, after extreme mobilization, could not be placed at the fundus of the scrotum except with considerable tension on the cord. In both cases the thigh was flexed, and gradually extended during the four or five subsequent days. The ultimate result was good in both instances. It would appear that, although tension is rare, a sharing of the connective tissue in the strain

protects the vessels to some extent; and that, by a gradual straightening of the thigh after, the circulation can accommodate itself gradually to the altered conditions.

Type II.—This embraces twenty-one operations; the average age was 8½ years, and the results were perfect in 60 per cent and fair in 15 per cent—that is, satisfactory in 75 per cent. Of the three fair results, however, one was a secondary orchidopexy after a previous failure (*Case* 24). Excluding this last case, the two others were over 11 years of age.

Of the four poor results, mobilization was omitted in two. In one (*Case* 12) the side mobilized yielded a good result; but when this was omitted on the other side the operation was unsuccessful (*see Fig.* 379). *Case* 16 is another instance of the same kind (*see Fig.* 380).

Now it is significant that in this group most of the testes were poorly developed. The peritoneum of the sac was exceedingly friable, and the poor development of the cord and vas was in proportion. The whole picture, together with failure of descent, is one of developmental failure. This view, held originally by Hunter, and upheld by succeeding generations, may have to be modified.

It has been shown that a normally formed testis can develop approximately to the normal in the inguinal canal. There is evidence in this series that a certain degree of descent and development can take place naturally, but that the result is neither complete nor satisfactory. *Cases* 8, 9, and 11 are such examples. On the other hand, a testis felt in the inguinal canal *may disappear* in the course of years. In *Case* 19 the left testis (felt some years previously in the inguinal canal) could not be found; yet the result of operation was satisfactory on both sides. These observations seem to show that while some measure of development and descent can be hoped for by natural processes, a completely descended and normal testis cannot be hoped for; while the possibility of a disappearance of the testis high up into the inguinal canal must be reckoned with.

Since testes in this group have been shown to develop to all appearances in a normal manner after scrotal replacement by the method described, and in view of the foregoing remarks, failure of descent perhaps should be regarded rather as a *delayed development* at the time of birth than a *defect in* development. If this view is correct, some of the fair and poor results may well slowly develop to the normal in the course of time; and perhaps only atrophy after operation can be regarded as a failure. Atrophy occurred in 10 per cent of the series.

With regard to treatment of the sac in these cases, no attempt was made to dissect it away or to divide the connective tissue of the cord. In one instance (*Case* 23) scrotal replacement on both sides was only possible with considerable tension on the cord. On both occasions the thigh was flexed and only gradually extended. The result was good on both sides.

In the series there is one other case which is instructive—*Case* 20. This was an instance of operating on the hernia and leaving the testis *in situ*. Subsequent orchidopexy five years later yielded an indifferent result. At the same time orchidopexy in the infant is not likely to be successful (*Case* 18, operated on at 2½ years: it is, however, possible that development may

proceed towards the normal in due course). On the whole it is probably wiser to make an effort to control the hernia by a truss (if necessary) until a suitable age for orchidopexy and the radical cure of the hernia at the same time.

CONCLUSIONS.

The following conclusions arise from a study of these cases :—

1. Imperfectly descended testes are to be classified into two groups : (*a*) *Ectopic*: Testis, tunica vaginalis, epididymis, vas, and cord well developed. No patent processus vaginalis. Descent alone imperfect owing to the failure of the scrotal portion of the gubernaculum. (*b*) *Imperfectly developed*: This group represents a retarded (rather than a defective) development capable of attaining the normal under suitable conditions. The development of all associated structures is rudimentary; and this, together with the imperfect descent of the testis, represents a general retardation of development of the parts concerned.

2. In both groups orchidopexy offers encouraging results provided adequate peritoneal mobilization forms an integral part of the procedure. The prognosis is best in the 'ectopic' variety. It follows that if on clinical examination an obvious hernial sac is present and the scrotum is undeveloped, the prognosis is not so good as when these features are absent.

3. The best age for operation is between 5 and 9 years. It is undesirable to perform orchidopexy much below the age of 5 unless it is necessary to cure an uncontrollable hernia.

4. It is useless to wait for complete natural descent and development. Though this result may in a measure be attained in the course of time, it is unlikely to be complete. Further, while a normal testis may develop to a fairly satisfactory degree in the inguinal canal, the true undescended testis will fail in this respect, and it may even ascend again to the internal ring.

5. If orchidopexy is performed without peritoneal mobilization, the testis will probably atrophy or be subsequently drawn up again into the inguinal canal.

6. Success or failure can only be estimated with certainty from six to nine months after operation. Accordingly, in double cryptorchids, it is advisable to wait about one year at least before operating on the second side.

7. There is no evidence in this series that testes brought into the scrotum are capable of spermatogenesis. On the other hand, the normal size, consistence, and sensation on examination (together with the normal development of the sexual characteristics in some of the older subjects) is hopeful. It is unlikely that testes apparently normal in every way should prove ultimately to be defective in this one respect.

In conclusion, I wish to express my thanks to Mr. George Gray and Mr. McNab for their help in tracing and collecting these cases; also to Mr. S. A. Sewell for his drawings.

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[1] Howard, Russell, *Practitioner*, 1907, 794.
[2] Southam and Cooper, *Lancet*, 1927, 805.
[3] Cunningham, *Anatomy*.
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THE X-RAY DIAGNOSIS OF RIGHT PARADUODENAL HERNIA.

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THERE is as yet no record that a case of right paraduodenal hernia has been diagnosed before operation. In 1906 Lord Moynihan wrote: "In a certain proportion of cases it is likely in the future that an operation will be undertaken after a correct diagnosis has been made."

FIG. 384.—Right paraduodenal hernia.

On April 3, 1926, a man of 32 years of age was admitted to the Dundee Royal Infirmary with a history suggesting chronic duodenal ulcer. He was operated on by my chief, Mr. John Anderson, who found that the whole of the jejunum-ileum, except the first and last three inches, was contained in a large right paraduodenal hernia. There was also a duodenal ulcer. On scrutinizing the X-ray films after operation one was struck by the bunched-like appearance of the small gut as if it were contained in a bag which prevented the various coils occupying any part of the peritoneal cavity (*Fig.* 384).

In January, 1927, a man of 24 years came up to my Out-patient Department with a history of pain coming on one hour after meals. This had been going on for four years and he was always worse in the forenoons. He relieved the pain by drinking water, but if he failed to do this the pain would last for an hour. He always felt as if he had eaten too much. He did not yield to medicinal treatment, and I had him X-rayed. The radiographer reported that the stomach was slightly prolapsed but definitely irritable. There was irregularity of the pyloric canal and much distortion of the duodenal cap. But the film (*Fig.* 385) appeared to me to be very similar to that of the

FIG. 385.—Right paraduodenal hernia diagnosed prior to operation from X-ray appearances. There was also a duodenal ulcer.

paraduodenal hernia shown in *Fig.* 384—there was the same suggestion of the small intestine being contained in a bag. I accordingly suggested that the condition was also one of right paraduodenal hernia, and my diagnosis was verified by Mr. John Anderson, who operated.

These two cases may be added to the 32 paraduodenal hernias collected by my colleague F. R. Brown,[1] bringing the total number of recoveries up to six, three being from Dundee.

REFERENCE.

[1] BROWN, F. R., *Brit. Jour. Surg.*, 1925, xiii, 367.

DIAPHYSECTOMY AND PRIMARY SUTURE FOR ACUTE OSTEOMYELITIS OF THE FIBULA.

By HAMILTON BAILEY,

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As far as the treatment of acute osteomyelitis is concerned, the fibula, by virtue of its anatomical and functional peculiarities, stands in a class by itself. It is for the fibula, and for the fibula alone, that diaphysectomy can be recommended unhesitatingly. The clean granulating wound which followed my first case of osteomyelitis of the fibula treated by this method emboldened me to try a primary suture on the next example to present itself. I have now carried out diaphysectomy with suture three times. The wounds have healed by first intention, and have remained healed—verily a surgical treat in a disease like acute osteomyelitis!

FIG. 386.—*Case* 1. Sequestrum removed from sinus which developed over upper end of the incision.

As I knew of a case where the external popliteal nerve had been divided in removing the diaphysis of the fibula, it came about that in *Case* 1, in the determination to ensure the integrity of this nerve, I left a piece of the upper end of the diaphysis behind. Six months later a sequestrum was removed from the bottom of a sinus which developed over the upper end of the incision (*Fig.* 386). The following method, which is practically fool-proof, has been used in the remaining three cases with great rapidity and satisfaction.

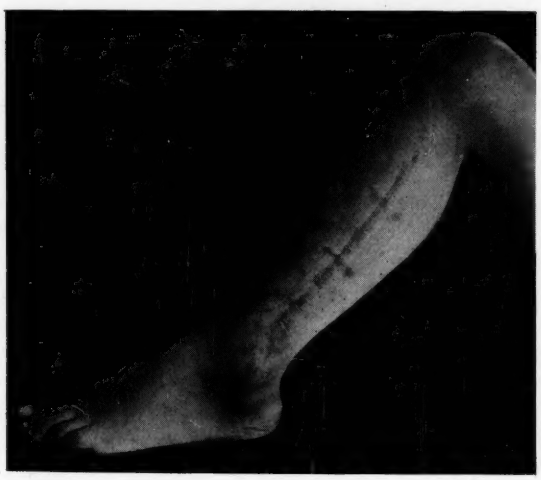

FIG. 387.—*Case* 3. Condition of the wound three and a half weeks after operation.

After the application of a tourniquet to the thigh the shaft of the fibula is exposed through an ample incision, the peronei being retracted anteriorly. Using Doyen's raspatory, the periosteum is cleared and the whole of the diaphysis resected with Exner's shears, just as though it were a rib. The lower end is divided first, and whilst the upper end is being sectioned with the shears, Doyen's raspatory remains *in situ* around the extreme upper end of the bone, protecting the nerve. As soon as the shaft of the fibula has been removed its bed is swabbed out with

a watery solution of flavine, and the wound closed by interrupted sutures, except for a glove drain in its lower end.

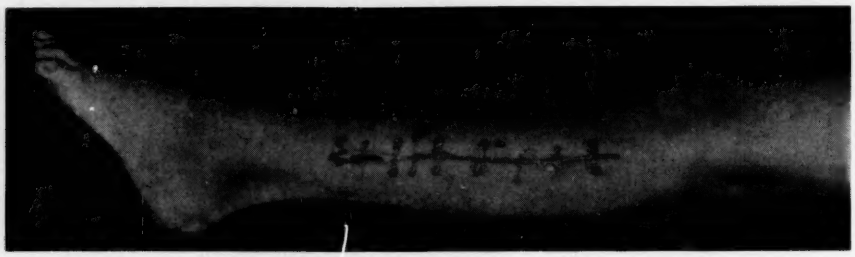

FIG. 388.—*Case* 4. Condition of the wound on the fifteenth day after operation.

Case 1.—A girl, age 12, was admitted with acute osteomyelitis of the fibula. Diaphysectomy was performed and the wound packed with strip gauze soaked in flavine. When the gauze packing was finally removed a clean granulating wound presented, which slowly filled in. After the patient returned from the convalescent home a sinus developed over the upper end of the wound. Six months later a sequestrum (*Fig.* 386) was removed from the bottom of the sinus, after which the wound firmly healed. The cause of the sequestrum has been referred to above.

FIG. 389.—*Case* 3. Showing regeneration of the fibula after diaphysectomy; skiagram taken eight months after operation.

Case 2.—Violet G., age 7, had been attending another hospital with cellulitis of the leg for three days. On admission the child looked ill. The temperature was 102°, and there was tenderness over the whole course of the fibula. At operation the diaphysis of the fibula was found in a bath of pus limited by the periosteum. Treatment was carried out by the method indicated above. The upper three-quarters of the wound healed by first intention; the remainder broke down somewhat, but the whole wound was soundly healed in three weeks.

Case 3.—Marie E., age 6, for three days had pain in the left leg. The temperature was 99°. There was tenderness over both the tibia and the fibula, and there was some doubt as to which of these bones was the seat of the disease. It was elected to explore the fibula, and pus was found within its periosteum. Diaphysectomy was performed and the wound closed with the exception of a glove drain. *Fig.* 387 shows the condition three and a half weeks after operation.

Case 4.—William S., age 10, had been kicked in the calf six days previously. The temperature was 101° and there were typical signs of acute osteomyelitis of the fibula. The diaphysis of the fibula was resected and the wound closed with the exception of a small soft rubber tube in the lower end of the incision. The wound healed by first intention, and *Fig.* 388 shows the condition of the wound on the fifteenth day.

No permanent disability attends the removal of the shaft of the fibula. A light plaster case can be applied as soon as the wound has healed, but this is not essential. The shaft of the fibula slowly regenerates (*Fig.* 389), but long before this the patient is walking normally.

THE RADIUM PROBLEM.

III. THE TREATMENT OF CARCINOMA OF THE RECTUM WITH RADIUM.

By Sir CHARLES GORDON-WATSON,
SURGEON TO ST. BARTHOLOMEW'S HOSPITAL, LONDON.

WITH AN INTRODUCTION ON THE SPREAD OF CANCER OF THE RECTUM.

By CUTHBERT DUKES,
DIRECTOR OF THE RESEARCH LABORATORY AT ST. MARK'S HOSPITAL, LONDON.

THE SPREAD OF CANCER OF THE RECTUM.

The possible paths of spread of cancer of the rectum are: (1) By direct extension through continuity of tissue on the surface and by infiltration into the rectal wall; (2) By the lymphatic system; (3) By the blood-stream.

Though all these paths may be made use of in the dissemination of an advanced cancer, it must not be assumed that each path is equally available from the beginning of the disease. Extension through continuity of tissue is naturally the first method of spread, and as long as this is the only means of extension cancer remains a local disease, capable of eradication by local excision. From the point of view of radium treatment also, as long as the malignant growth is limited to the immediate region of its origin, satisfactory results may be expected from marginal radiation; but as soon as vascular or lymphatic dissemination has commenced the surgeon is faced with a much more serious problem. A knowledge of the period in the development of cancer of the rectum at which venous or lymphatic spread is likely to begin would be a useful guide to treatment. This question is now considered in the light of recent pathological investigations.

THE SPREAD OF CANCER OF THE RECTUM THROUGH CONTINUITY OF TISSUE.

Cancer of the rectum commences as a proliferation of the columnar epithelium of the mucous membrane, and in its earliest stages takes the form of a mass of atypical epithelium growing in the mucous membrane and protruding to a greater or less extent into the lumen of the bowel. Thus, whether the malignant process begins in a previously level portion of mucous membrane, in a small patch of epithelial hyperplasia, or in a papilloma or adenoma, its first general architecture is that of a protruding epithelial mass. The amount of surface proliferation varies greatly in different cases and is dependent chiefly on the degree of deep infiltration of the rectal wall, which, as will be shown later, leads to a complete transformation in the general

contour of the growth. Meanwhile the surface growth enlarges by marginal increase, which tends to be greater in the transverse than in the longitudinal axis of the rectum, and its depth increases by infiltration of the rectal wall. The characteristic features of this deep infiltration are that the growth is more extensive in the submucosa than in the mucous membrane, resulting in an undermining of the mucous membrane at the edge, and that infiltration through the muscle coat takes place by root-like projections which push their way between the segments of the circular muscle. By the time the growth has reached the muscle it has commenced to ulcerate, usually opposite the point of deepest infiltration. The traditional classification of cancer of the rectum into protuberant and ulcerating types is misleading in so far as it suggests that these are different types of growth. Ulceration is due to interference with the surface blood-supply and to local sepsis. It commences at a predictable moment in the progressive evolution of the early protuberant tumour into the late excavated ulcer with raised edges.

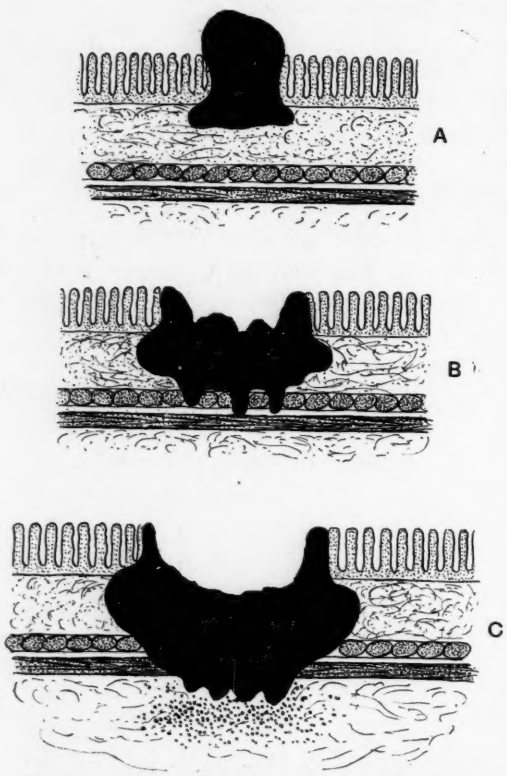

FIG. 390.—Diagram to illustrate classification of carcinoma of the rectum into A, B, and C cases according to depth of spread by direct continuity.

No constant relationship exists between the extent of the surface growth of cancer of the rectum and the depth of extension by continuous infiltration. Protuberant malignant proliferations, almost completely surrounding the rectum, may be limited to the mucous and submucous coats, whereas a small ulcerating growth may have spread by deep roots extending into the perirectal tissues. The only generalization as to depth of spread which can be made from an unaided eye inspection is that tumours which project into the lumen of the rectum are not usually accompanied by much infiltration of the submucous and muscular coats, and that excavated ulcers with raised edges are usually associated with a spread by direct continuity into the perirectal tissues.

All cases of cancer of the rectum at St. Mark's Hospital are classified for the purpose of prognosis according to the depth of spread within the rectal wall. The system adopted is a modification of a clinical classification into **A**, **B**, and **C** cases (*Fig.* 390), suggested by Lockhart-Mummery[1]. **A** cases are malignant tumours in which the growth extends into the submucosa, but not into the muscle coat (*Fig.* 391). **B** cases are malignant tumours in which the growth extends into the muscle coat, but has not spread by direct continuity

FIG. 391.—Carcinoma of the rectum, A case. Longitudinal slice of the wall of the rectum to show the general shape of a cancer which has spread only as far as the submucosa.

FIG. 392.—Carcinoma of the rectum, B case. Longitudinal slice of the wall of the rectum showing commencing ulceration in the centre of the cancer opposite the point of maximum infiltration of the muscle wall.

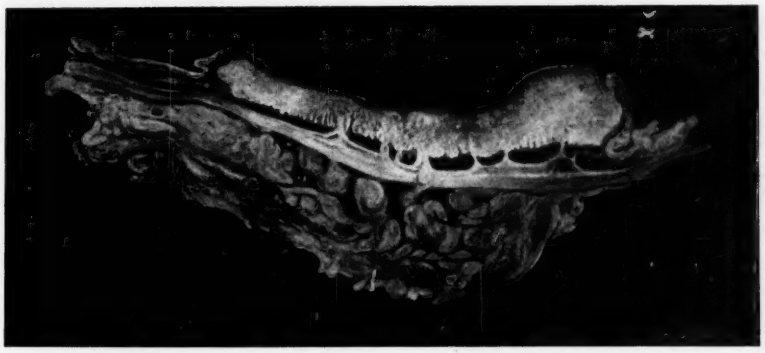

FIG. 393.—Carcinoma of the rectum, early C case. Longitudinal slice of the wall of the rectum, showing the manner in which a malignant growth invades the muscle coat by means of roots which push their way between the segments of the circular muscle.

into the perirectal tissues (*Fig.* 392). **C** cases are malignant tumours which have spread by direct continuity into the perirectal tissues (*Figs.* 393–395). **B** cases may be further subdivided into **B1** in which the circular muscle is the limit of growth, and **B2** in which the longitudinal muscle has been reached. **C** cases may also be subdivided into **C1** without glandular involvement, and **C2** with metastasis in the lymphatic glands. This classification is made after microscopic examination of big sections through the fixed and hardened tissue. It may be of interest to remark that opinions expressed in advance, either before operation or immediately after removal of the tumour, usually err on the side of too favourable a prognosis.

FIG. 394.—Carcinoma of the rectum, **C** case. Longitudinal slices through the walls of the rectum showing ulceration appearing opposite to the point of maximum infiltration of the wall of the bowel.

FIG. 395.—Carcinoma of the rectum, **C** case. Longitudinal slices through the walls of the rectum in an ulcerating carcinoma with metastases in glands accompanying hæmorrhoidal vessels.

Table I.—CLASSIFICATION OF RECTAL CANCER ACCORDING TO DEPTH OF SPREAD IN 100 CASES.

A cases	1
B „	24
C „	75
Total	100

Of the B cases 12 were B1, and 12 B2
Of the C „ 35 „ C1, and 40 C2

Table I records the results of the application of this method of classification to the last 100 cases of cancer of the rectum operated on at St. Marks' Hospital.

THE SPREAD OF CANCER OF THE RECTUM BY THE LYMPHATIC SYSTEM.

The spread of cancer of the rectum through continuity of tissue is usually a slow process. Judging from clinical histories, several months may be occupied by the progressive extension through the rectal wall. It is important for the surgeon to know at what stage in this slow erosion of neighbouring tissue the much more rapid and far-reaching spread by lymphatics is likely to commence. Information on this point is supplied by recording the frequency of metastasis in the anorectal and retrorectal lymphatic glands in **A**, **B**, and **C** cases, as in *Table II*.

Table II.—Proportion of Glandular Metastasis in A, B, and C Cases.

Type of Case	Total	Number with Metastasis in Lymphatic Glands
A	1	0
B	24	0
C	75	40

These striking figures seem to justify the conclusion that metastases do not form in the anorectal or retrorectal lymphatic glands until the cancer has spread by direct continuity into the perirectal tissues. On the present evidence, however, this must not be accepted as a rule without any possibility of exception, because the number of **A** and **B** cases which have been available for study is not large enough to permit an unqualified statement. Two other limitations in the methods used must be admitted. The material available for study consisted of the tissue removed by the operation of perineal excision, and it may be argued that lymphatic dissemination might have occurred to more distant glands without affecting those in the immediate neighbourhood of the growth. Again, it was not the practice to attempt to dissect out every gland attached to the excised rectum, the general routine being to remove for microscopic examination three or four lymphatic glands from the perirectal tissues round the growth, any enlarged and easily palpable glands from elsewhere, and a small piece of tissue including the superior hæmorrhoidal vessels. Experience showed that microscopic examination of these selected tissues was sufficient to settle the question of the presence or absence of glandular metastases, and it also provided many forcible reminders of the fact that enlarged and hard lymphatic glands do not necessarily contain cancerous metastases. The enlargement of the anorectal and retrorectal lymphatic glands in ulcerating cancers of the rectum is often due to inflammation, and the increased hardness to fibrosis.

In view of the limitations imposed by the method of investigation and the small number of **A** and **B** cases available for study, the figures recorded in *Table II* should be taken as an expression of what commonly occurs and not as the enunciation of an infallible rule. The facts may be expressed by

saying that spread to the anorectal and retrorectal lymphatic glands does not usually occur until the cancer has spread by direct continuity into the perirectal tissues.

Ernest Miles[2] has often stressed the importance of lateral and downward spread in addition to spread by the lymphatic glands accompanying the superior hæmorrhoidal vessels. In our series of 100 cases this was looked for by cutting the hardened tissue with a sharp knife and removing for microscopic examination any suspicious-looking plaques or glands. Evidence of lateral extension along the surface of the levator ani muscle was found in only one case, and downward extension across the ischiorectal fossa in three cases. These were all four **C** cases with metastases in the anorectal lymphatic glands, and in two of the cases of downward spread it appeared as if the cancer was spreading by direct continuity rather than by lymphatic channels. Once lymphatic dissemination has commenced, it may follow many different paths, as Semba has recently proved.[3]

THE SPREAD OF CANCER OF THE RECTUM BY THE BLOOD-STREAM.

We have no means of telling whether or not venous embolism occurred in any of these 100 cases. The possibility of vascular embolism introduces an unpredictable factor into all estimates in the prognosis of rectal cancer, but fortunately this accident is sufficiently rare not to upset calculations based on other factors. All that can be said about its frequency is that, on general principles, it is more likely to occur the longer the disease has lasted. It is more likely to occur also when the malignant process has spread deep in the bowel wall into the region of the larger veins—in other words it becomes progressively more possible as the disease advances through the **A**, **B**, and **C** categories.

CONCLUSIONS.

These observations on the spread of cancer of the rectum lead to the following conclusions of interest in relation to radium treatment :—

1. In three-quarters of the cases of cancer of the rectum accepted by surgeons as operable, the cancer has already spread by direct continuity into the perirectal tissues. These are classed as **C** cases.

2. In more than half of these **C** cases the anorectal or retrorectal lymphatic glands contain metastases.

3. Cancer of the rectum commences in the mucous membrane and extends slowly by direct extension through continuity of tissue on the surface and by infiltration of the rectal wall. As a rule lymphatic dissemination does not play any part in the spread of cancer of the rectum until the growth has spread by direct continuity into the perirectal tissues.

4. It is not possible to tell in advance whether the growth has spread only into the submucosa (**A** case), or into the muscle coat (**B** case), or into the perirectal tissues (**C** case), though it may be stated in general terms that **A** cases are freely movable and more so than **B** cases, and that **C** cases present varying degrees of fixation. The only generalization that can safely be made is that protuberant growths are more likely to be **A** or early **B** cases without lymphatic metastases, whereas excavated ulcers are more likely to be **C** cases with at least a 50 per cent probability of lymphatic spread.

THE TREATMENT OF CARCINOMA OF THE RECTUM WITH RADIUM.

(Sir Charles Gordon-Watson.)

If the results of the investigations which Dr. Dukes has made in 100 excised rectums are confirmed in a larger series of cases, and if a case can be safely diagnosed as **A** or **B** (and therefore presumably free from lymphatic spread), it seems evident that the present practice of radical excision with colostomy for all such cases may in the future be regarded as unnecessary; and that a local resection may again be looked upon as a sound surgical procedure, with as good a prospect of cure as more radical measures. Though a good case can be made out for the use of radium in preference to radical excision in a small and easily accessible growth, it is doubtful if, at the present time, the employment of radium could be advocated in preference to a simple local resection except in those instances in which operation is refused. Two cases of this nature treated with radium in which operation was refused have now been under observation for over a year. These patients have escaped colostomy and remain well.

There are, however, cases of the **A** or **B** type which are situated so near the anal margin that even a local resection demands a preliminary colostomy. In these cases an adequate attack with radium without barrage of the lymphatic areas and without colostomy might well be justified: if radiation proved unsuccessful, a surgical cure would still be possible.

It is not often that a carcinoma of the pelvic portion of the rectum—that is, above the peritoneal reflection—comes into the surgeon's hands in the **A** or **B** stage. Any operation for a growth in this situation, short of a radical excision with colostomy, is fraught with considerable surgical difficulty and risk. In this type of case the employment of radium should be considered, and if the general condition of the patient is at all unfavourable to radical operation, should certainly be given a trial.

Unfortunately histological evidence from the excised rectum does not enable the surgeon to classify his advanced cases into **C1** and **C2**, but it is certain that a fixed and ulcerating growth belongs to the **C** class, and, if firmly fixed and clinically advanced, that it belongs to **C2**. It becomes obvious that in this class any attempt at radical radiation must include an efficient barrage of the lymphatic areas. In this connection it is important to note that Dukes' results indicate that the upward line of spread, along the superior hæmorrhoidals, is of paramount importance, and the middle and inferior hæmorrhoidal areas of minor importance, except when the anal canal is involved. Further, it is clear that any attempt at radical treatment must include a laparotomy, and investigation of the liver and the pelvic lymph-glands, which if involved can be attacked from above (*see below*) more efficiently than from below.

If secondary deposits have reached the lymphatic glands at the brim of the pelvis, it is obvious that the case is not far from hopeless. Nevertheless I have frequently proved that enlarged glands in the mesorectum are inflammatory and not malignant, and it is comparatively easy, especially with seeds, to barrage the inferior mesenteric lymph-track along its whole length.

RECTAL RADIUM THERAPY.

Although radium has been employed in the treatment of cancer of the rectum in this country for thirty years or so, it is only within the last five years that we have attempted to treat the disease by a combination of surgery and radiation, and our present knowledge of the effects of radiation does not

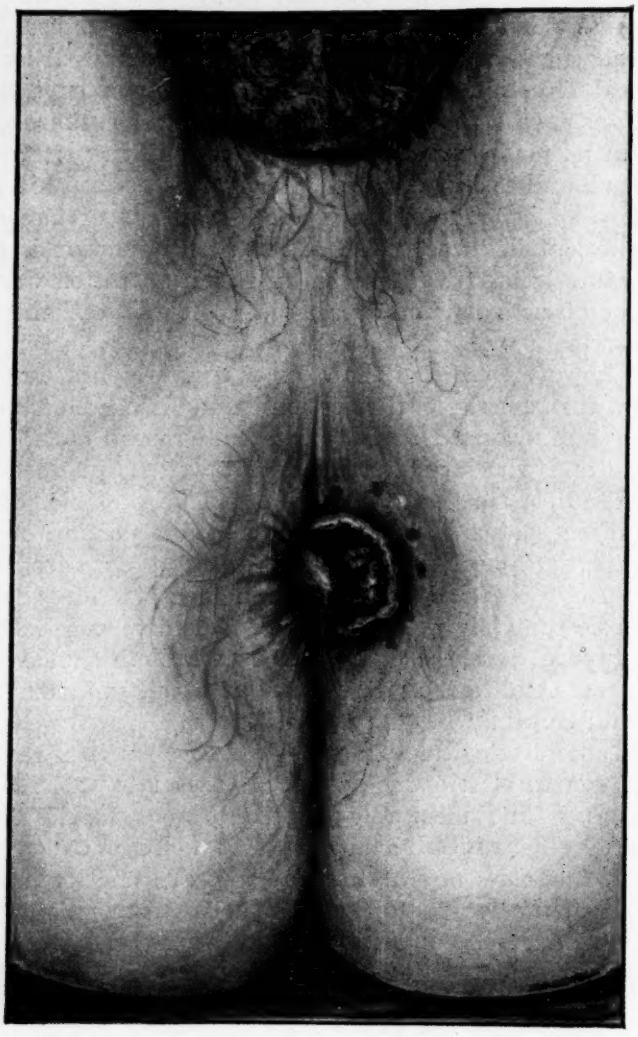

FIG. 396.—Epithelioma of anus treated with needles. (*Mr. Milligan's case.*)

allow accurate deductions to be made as to the changes which may be expected to follow a given type or degree of radiation.

Tissue response to radium depends upon several varying factors about which at the present time we have little knowledge. We know that the more specialized the malignant cell, the more radio-resistant it is; and the more the type conforms to embryonic tissue, the more radio-sensitive it is.

Adenocarcinoma of the rectum has in the past been generally regarded as very radio-resistant. My experience of the last five years leads me to believe that this impression has arisen in part from the difficulty of access, as compared with the cervix uteri, the tongue, and the breast, and that when a uniform and complete barrage of the growth is possible, results are often

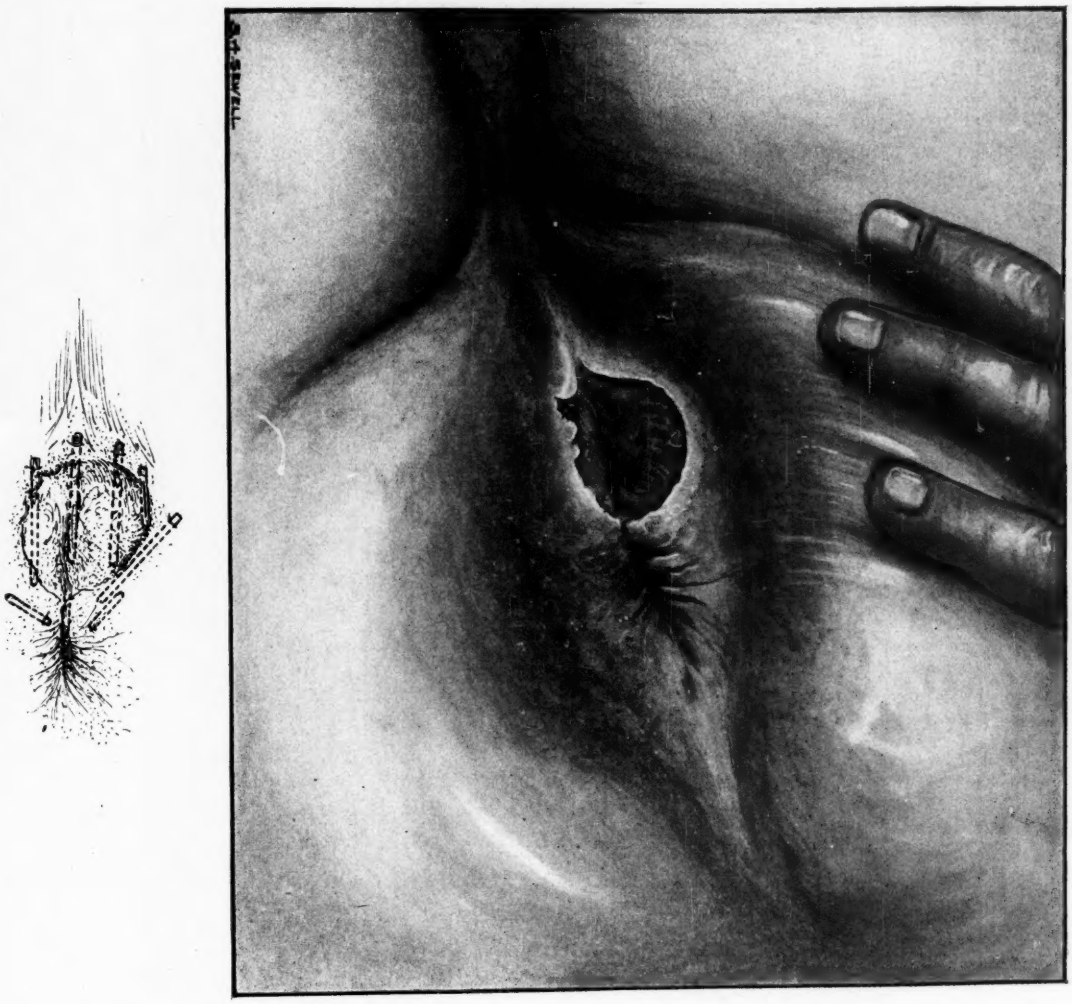

FIG. 397.—Typical appearance three weeks after interstitial radiation of epithelioma of anus. (*Author's case.*)

good. Unfortunately experience shows that two apparently similar cases treated on similar lines may respond in one instance well and in the other badly.

With the help of surgery a fair proportion of advanced low rectal carcinomas can be exposed from behind and mobilized in such a way as to give access to all parts of the tumour so that a uniform barrage can be secured. Further, high growths which extend above the peritoneal reflexion can be

dealt with successfully, though with greater risk, by approach through the peritoneal cavity. Squamous-celled carcinoma involving the anal canal and perineal skin can be relied on to respond to radium with far more certainty than columnar-celled carcinoma, and if seen in the early stages can be cured without resort to colostomy (*Figs.* 396–399).

FIG. 398.—Same case as shown in *Fig.* 397, a fortnight later.

During the past five years the author has treated over 90 cases of cancer of the rectum with radium, and the majority of these have been regarded as inoperable. In the past those cases considered unsuitable for excision have in most instances been submitted to colostomy, to prolong life without hope of cure. Many of these inoperable cases are now available for radium treatment combined with colostomy, and experience shows that, in addition to the benefit secured by colostomy, they are afforded some prospect of cure. While it is impossible to be dogmatic at the present time, it may be affirmed

with some confidence that radium should be employed for the *fixed inoperable growth* if reasonably accessible to radiation, and if no visceral metastasis is discovered.

In *borderline cases* the general operative risks must be assessed. For example, most surgeons hesitate to advise excision in stout elderly patients with a tendency to bronchitis, and regard the male with more fear than the

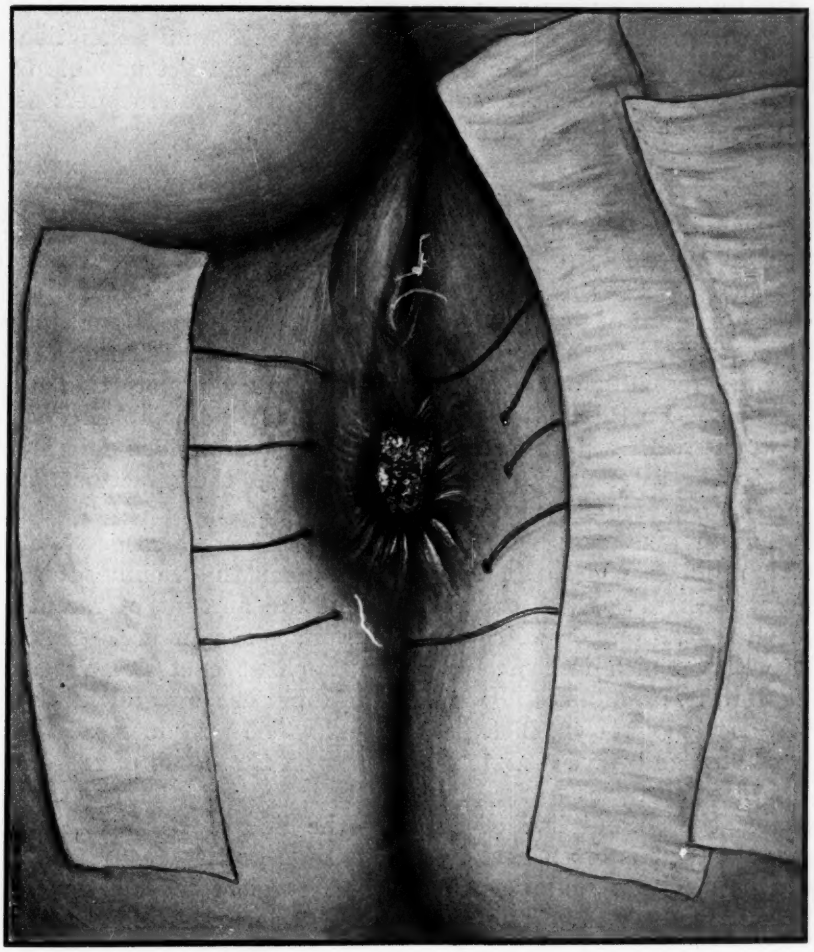

FIG. 399.—Perirectal radiation for epithelioma of the anus.

female; in such cases the alternative of irradiation is welcomed. The local conditions which favour excision rather than radium must be balanced up with the general. For example, a growth which involves the anterior wall of the perineal portion of the rectum in the male with some fixation is not very accessible to uniform radium implantation, and local conditions are more favourable to excision. On the other hand, a growth involving the pelvic portion of the rectum is accessible to abdominal radiation, and excision may only be possible by the abdomino-perineal route. In the latter case the

increased operative risks may strengthen the arguments in favour of radium treatment, especially if the age and general condition of the patient are regarded as unfavourable for radical surgery.

At the present time, in the author's experience, the results of irradiation of *operable growths* are for the most part too recent to justify an expression of opinion in favour of radium in preference to operation. There is no doubt that when radical excision is refused, or contra-indicated on grounds of general health, radium offers a promising alternative, and it may be stated definitely that when the growth is small and accessible, successful irradiation can be secured without the stigma of a colostomy. It is not yet possible to review results and assert that rectal irradiation of an early growth offers as good a hope of permanent cure as radical surgical excision.

RADIATION TECHNIQUE.

Given an accessible primary growth, the key to successful radiation in any individual case lies in the correct assessment of the amount of radium required, the method of distribution, the time it should be left in, the amount of filtration required to secure a pure γ radiation, the prevention of sepsis or necrosis from β radiation or excessive γ radiation, and the protection of adjacent healthy tissues. Further, if surgical radiation is to be completely successful, a healed wound with restoration of function, without serious deformity, must be added to the assessment. In other words, all these factors have to be determined to assess and secure the *optimum* dose. To arrive at an optimum dose in any individual case is the outstanding problem which besets all radium workers, a problem which can only be solved as the volume of experience grows. An incorrect assessment, whether of the amount of radium, of the time, of the filtration, or of the distribution, spells failure. Other factors come into play which influence the dose, such as excessive vascularity or excessive fibrosis, proliferation or ulceration, rapid or slow growth, and doubtless other, as yet unknown, biological factors which may increase or diminish radio-sensitivity and have a material bearing on the detail of radiation.

With these obstacles to face in the attack on the primary growth, there still remains the second line of defence—the line of lymphatic spread—to overcome, one that is often held by an invisible host.

Enough has been said to indicate that surgical radiotherapy demands intensive case study, and years of constant practical application to the subject, to ensure a fair measure of such success as is possible. The time is not yet ripe when the measure of possible success can be computed.

In the early days of rectal radium therapy tubes containing 50 mgrm. of radium or more were inserted into the lumen of the rectum, and repeated for short periods of about twenty-four hours at a time, and though in some instances cures were recorded, in the majority only the surface area of the growth was destroyed by radio-necrosis and little permanent benefit ensued. Frequently severe radium burns followed this method, resulting in great pain and distress to the patient. Such results as these were inevitable, having regard to the irregular contour of most rectal growths and the mechanical impossibility of accurate and uniform radiation to all parts of the growth by

means of a central tube, and bearing in mind the important fact that the intensity of radiation varies inversely as the square of the distance.

A new chapter on rectal radium therapy was opened when in 1924 Neumann and Coryn, of Brussels, described a method of interstitial radiation with needles after surgical exposure of the growth from the perineum. The author paid a visit to Neumann's Clinic early in 1925, and with the aid of radium supplied by the Medical Research Council commenced research on the lines of the Brussels Clinic. During the first two years of this research a limited number of advanced inoperable cases were attacked. After a preliminary colostomy the rectum was exposed from behind after removal of the coccyx and separation of the levatores ani. The growth was mobilized as far as possible to enable needles to be inserted to all parts of the growth. In the female the anterior portion of the growth was attacked through the posterior vaginal wall (*see Fig.* 405). Needles were passed along the lines of lymphatic spread upwards, laterally, and downwards in the course of the hæmorrhoidal vessels. The full details of the operation have been described elsewhere.[4] Subsequently inoperable growths above the peritoneal reflection were attacked through the abdomen, at first with needles and later with radon seeds.

During the last two years a certain number of operable growths have been radiated; a few early **A** cases by intrarectal puncture with seeds, and others of the **B** or early **C** type by open perineal or vaginal needle puncture without colostomy. The technique in inoperable cases has been further developed by combined intra-abdominal and perineal (or vaginal) attack, and also by intrarectal radon seed implantation combined with perirectal radium needle puncture through the skin, in cases in which either on general grounds or because of local difficulties an open operation has been considered inadvisable.

Filtration.—The filtration employed has been 0·5, 0·6, and 0·8 mm. of platinum. It is desirable to avoid all risk of β radiation within the peritoneum, and a filtration of 0·8 which cuts out all primary β rays seems desirable and is now being used when available. When a considerable amount of radium is implanted into a rectal growth below the peritoneum, it is probable that better results will be secured with the same filtration (0·8), but in any case 0·6 mm. platinum eliminates 99·9 per cent of the β rays and is preferred to 0·5.

Needles.—In order to secure uniform radiation it is desirable that the needles employed in any one case should all be of the same linear intensity—for example, 1 mgrm. per 1·6 cm. of active length. For rectal work it is advisable to employ needles of varying length. Long needles (active length 4·8 cm.) passed along the lines of lymphatic spread, containing 3 mgrm. each, are very useful, and needles containing 2, 1·5, 1, and 0·5 mgrm. of the same linear intensity (1·6 cm. per 1 mgrm.) should be used in order to secure a uniform and complete barrage of a growth—which may vary considerably in thickness and present considerable irregularity at the margins. As far as possible the needles are inserted parallel to one another and the periphery of the growth encircled. An attempt is made to deliver 1 mgrm. of radium to each cublic centimetre of growth. (*Fig.* 400.)

The Time Factor.—There is still some difference of opinion among radium workers with regard to the use of heavy doses for a short period, or

smaller doses for a longer period. The radio-sensitivity of cellular tissue is known to vary considerably according to its nature—for example, columnar-celled carcinoma is more radio-resistant than squamous-celled carcinoma, lymphosarcoma far more radio-sensitive than any carcinoma, and a rapidly growing tumour is more sensitive than one that grows slowly. The stages of development of a cell, whether actively secreting, in mitosis, or at rest, are factors which have to be considered. Experimental work shows that tissues which are most active in mitosis are most susceptible to radium, and further that mitosis is inhibited soon after the application of radium, though it returns about four days later in disordered fashion and is soon followed by cell disintegration. Experimental work seems to indicate that the period of time

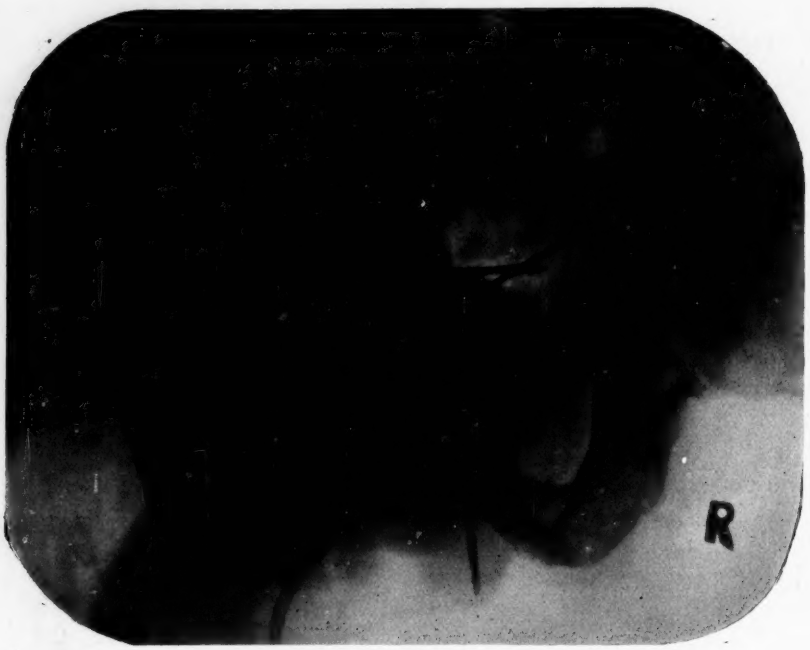

FIG. 400.—Radiogram showing posterior barrage with needles.

required to inhibit and disintegrate a number of cells in different stages of activity (given an adequate dose) is not less than about seven days. Ten days has been adopted by the author as the approximate standard of time for rectal radiation, though shorter periods are adopted within the abdomen (five to eight days) owing to the great susceptibility of the peritoneum to irritation.

Biopsy.—Whenever considered desirable a portion of growth is removed for section. In the earlier cases this was done at the time of the colostomy operation by means of a special punch. In later cases a portion has been removed at the same time as the needles. By the latter method there is less likelihood of stimulating metastasis. When early growths have been dealt with it has been considered inadvisable to disturb the growth for the purpose of biopsy.

INDICATIONS FOR RADIUM.

The following advantages can be secured by the use of radium appropriately applied in adequate dosage :—

1. In cases too advanced for radical surgery : (*a*) A few cases will respond so well that the growth can be destroyed and a cure result. (*b*) The growth in some instances can be reduced in size and rendered sufficiently mobile to permit of excision. (*c*) In the most advanced cases pain can be relieved, hæmorrhage checked, and excessive secretion reduced. (*d*) Local recurrences following excision, and secondary glands in the groin, can be completely destroyed. (*e*) Radium may be employed as a secondary measure to deep X-ray therapy in cases too advanced to attempt radical treatment with radium by open operation. Preliminary treatment by deep X-ray therapy has in one case produced improvement so that radium treatment became possible.

2. In cases considered suitable for radical operation but in which a radical operation is contra-indicated on other grounds, or is refused by the patient, radium offers high hopes of a cure.

3. In cases favourable for radical operation : such excellent results have been secured in a limited number of cases as to justify the employment of radium in operable cases when the patient is averse to a major operation, or when the general state of the patient's health is such as to increase the risks. In some a successful result has been secured without a colostomy, which is essential to sound radical surgery. No operable case treated with apparent success in this way has been under observation long enough to express an opinion as to the chance of recurrence, though several have continued well up to two years. On the other hand, some of these growths have not responded as expected and excision has been carried out after radiation.

METHODS OF ATTACK.

The following methods have been adopted by the author for radiation of rectal carcinomas, separately or in combination : (1) Barrage by *open operation* from the perineum with needles after preliminary colostomy ; (2) Intra-abdominal radiation with needles or seeds ; (3) Radiation through the vagina ; (4) Intrarectal radiation with needles or seeds ; (5) Radiation through the perineal skin ; (6) Surface radiation (on Columbia paste). Up to the present it has not been possible to employ distant 'bomb' therapy. A certain number of cases have been treated by deep X rays prior to radium, and a few by X rays after radium.* In all the earlier cases a preliminary colostomy was insisted on. During the past year or so a number of cases of the operable class have been dealt with without colostomy, and some of them successfully up to date.

The Open Perineal Operation (Posterior Barrage).—The technique of the perineal operation consists, in brief, of removal of the coccyx, division of the

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* Douglas Quick, of New York, has employed 'bomb' therapy in a large series of cases, with some excellent results, as a preliminary to interstitial therapy.

median raphé at the junction of the levatores ani, and free exposure of the ampulla of the rectum (*Fig.* 401). The lines of lymphatic spread along the superior, middle, and inferior hæmorrhoidal arteries are then barraged, and subsequently the growth is uniformly needled so that all parts of the growth, especially the periphery, receive as far as possible uniform radiation of not less than 1 mgrm. per c.c. In the female the anterior portion of the growth is barraged through the posterior vaginal wall. The time factor is usually ten days, and from 30 to 60 mgrm. of radium are employed according to the size and extent of the growth. The wound is packed with flavine gauze and kept moist by the Carrel-Dakin method, the skin wound being temporarily closed until the radium is removed. The wound is slow to heal and usually takes about six weeks to close. The primary reaction is usually slight, but sometimes in feeble individuals radiation is followed by extreme weakness, loss of appetite, and occasional vomiting—a group of symptoms, however, which has never proved fatal.

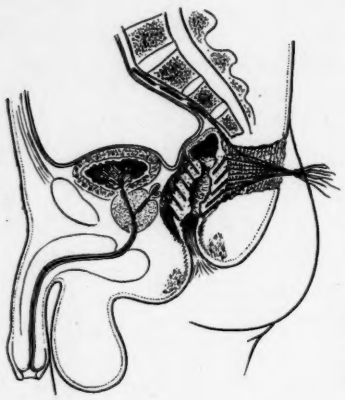

FIG. 401.—Interstitial radiation by the posterior barrage method for an annular growth.

Very little change can be noted in the size of the growth under four to six weeks, and the most marked change occurs in the third month; but usually after a short period of increased secretion of mucus, unless an overdose has been given, the local symptoms are relieved and hæmorrhage and tenesmus are checked. The most striking feature in these cases is, that as soon as the immediate effects of the operation and radiation are passed, the general condition of the patient improves rapidly, and even when no diminution can be noted in the size of the growth, the patient recognizes that his condition has improved enormously.

In the case of a growth which has ulcerated deeply, perforation may result during the stage of separation of the rectum from the parietes, and sepsis, which is not easy to control, may inhibit effective radiation and seriously prolong convalescence. If this complication seems probable, the perineal operation should be avoided and an attempt be made with intrarectal seeds, fortified by perirectal needles passed through the perineal skin. If the operation has been undertaken and fixation is extreme, puncture should be made through the levators to avoid risk of perforation in separating them from the growth. In some instances of a similar type perforation follows soon after radium puncture, with the disadvantages already mentioned. Nevertheless, if the radiation has been adequate these cases will heal. In one instance of this nature, operated on without colostomy, perforation occurred and a severe and fatal sepsis followed.

If advanced inoperable growths are treated on palliative lines, care must be exercised when the growth involves the base of the bladder. Too intensive radiation on this situation has precipitated perforation into the bladder. In such cases radiation should only be employed when pain,

tenesmus, or hæmorrhage makes the patient miserable. Perforation into the ischiorectal fossa, with secondary suppuration, is a definite contra-indication to radium.

Experience shows that whenever deep ulceration is present the needles should be confined to the periphery of the growth and the non-ulcerated areas of the growth, and the dose should err on the light side.

Adenocarcinoma, though resistant, is not insensitive to radiation, and large doses are required; but an overdose usually results in radio-necrosis and consequent sepsis even though the β rays are practically eliminated with adequate filtration. Herein lies one of the great difficulties in dealing with the large inoperable growth, and it will be many years before experience will determine the optimum dose in any given case.

If a small tumour is adequately treated and responds favourably, either the growth will be destroyed and repair take place without appreciable deformity (an optimum dose); or a cicatrix will form which will be followed by the gradual formation of stricture which, unless controlled, will end in stenosis (an excessive dose); or the growth will retrogress almost entirely but not completely, and subsequently show increased activity (an inadequate dose); or there may be practically no response (a radio-resistant tumour). In the case of large growths it seems necessary to push radiation to the full extent so that cicatricial contraction follows and ultimately stricture and stenosis, and this means that for the large inoperable growth colostomy is essential, quite apart from the necessity of examining the liver and the pelvic lymph-glands and attacking the latter from above if thought wise.

It is therefore evident that it is extremely difficult to hit the happy medium between a full dose and an overdose. It might be argued that it would be wiser not to risk a full dose and to be prepared to repeat radiation if necessary. Unfortunately, primary radiation tends to produce an increased degree of radio-resistance, and this method cannot be advocated. Rectal radiation is followed by a considerable degree of perirectal fibrosis, which diminishes the blood-supply to the part and tends to render subsequent irradiation ineffective, apart from any immunity (if such occurs) which the cancer cells may have acquired.

It is important to recognize the perirectal fibrosis which occurs as a part of the radiation process, otherwise an inexperienced worker might mistake it for extension of growth. In a case which progresses favourably this nodular fibrosis gradually diminishes and finally disappears, though the end-result may be complete rectal stenosis. In the post-operative treatment, regular three-hourly instillation of flavine (1–1000) through the catheters inserted into the wound at the time of operation must be insisted on, and after removal of the radium strict Carrel-Dakin treatment is carried out. When the wound starts to heal, ultra-violet light hastens the process, which may be assisted by a dressing of 1 per cent radiostol in paraffin. Cystitis is a common complication, but can usually be avoided or rendered harmless by the method which Dukes has advocated for excisions.[5]

The following case is a good example of a posterior barrage followed by apparent cure. The case is particularly striking in view of the age of the patient.

Case 1.—Female, age 39. Inoperable fixed annular carcinoma commencing 5 cm. from the anal margin; the upper limit was not defined. Preliminary colostomy was followed by posterior barrage (April, 1926). Thirty needles containing 38 mgrm. radium were left in position for seven days; two needles, each 5 mgrm. were inserted through the posterior vaginal fornix for seventy-two hours: total dose, 7104 mgrm.-hours. The growth retrogressed and a fibrous stricture followed. The patient remains well and free from evidence of growth (now four years since radiation).

Abdominal Radiation.—Whenever it is decided to treat an inoperable case of carcinoma with radium the abdomen should be opened and the liver

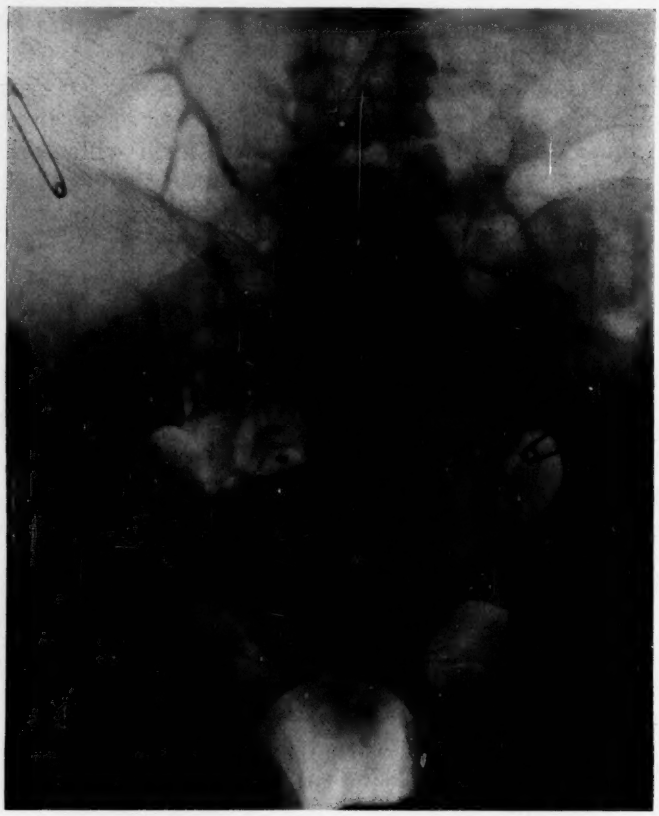

FIG 402.—Radiogram showing abdominal radiation with seeds to growth and glands.

examined. If there is no evidence of hepatic metastasis, the growth is examined from above, and the mesorectum, mesosigmoid, and iliac regions are explored for lymphatic enlargement. If the growth is partly or entirely above the peritoneal reflection, effective radiation from below is either impossible or both difficult and dangerous.

Many of these cases have been dealt with by radium-puncture with needles or seeds (*Fig.* 402). When the growth is situated entirely above the peritoneum seeds present many advantages. They can be buried in the substance of the growth in a uniform manner with less risk of intestinal leakage, and into the mesentery behind and above the growth. The efficiency of the

radiation depends on the extent of the growth and the presence of adhesions. It may be fairly easy to define the limits of the growth and to secure a uniform barrage, or it may be impossible to define the growth accurately and to be sure that the malignant area has been encircled, or to avoid puncture of the lumen. The amount of radium employed has varied considerably according to the size of the growth. The milligramme-hour dose has varied from about 2500 in small to about 6500 in large growths. Needles are left in from five to eight days and the radon seeds are left permanently *in situ*. The first stage of the colostomy is carried out at the conclusion of the radiation.

FIG. 403.—A specimen of carcinoma of the rectum under the care of a colleague removed post mortem after abdominal radiation. The necrotic space in the middle of the specimen is a needle track. This track communicated with the lumen of the rectum and the peritoneal cavity. Death was due to peritonitis.

It is not essential to drain the peritoneum when seeds are employed; most of the cases have not been drained. If needles are employed drainage is essential and packing-off of the radiated area advisable. The strings attached to the needles are brought up to the abdominal wall, but buried beneath the skin. When needles are employed it is advisable if possible to delay opening the colostomy until after their removal from five to eight days later. When seeds are used the colostomy can be opened whenever necessary.

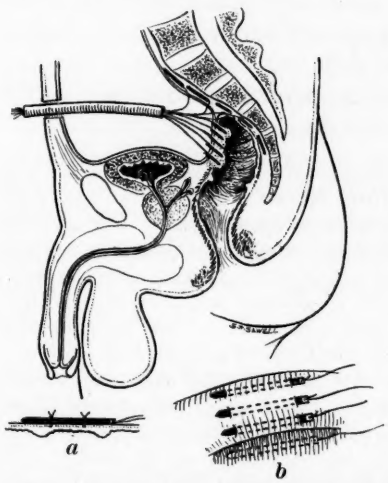

FIG. 404.—Abdominal radiation with needles. *a* and *b*, alternative method of using needles within the abdomen.

The employment of needles in supraperitoneal growths is a more formidable, but probably a more efficient, procedure. Great care is required to avoid puncture of the lumen of the bowel and establishing a track between the peritoneal cavity and bowel—a track which soon becomes enlarged by radio-necrosis (*Fig.* 403). In one instance a fatal peritonitis resulted from this cause. It is desirable to insert the needles in the long axis of the bowel, and not at right angles to it, and for this purpose it is necessary to be provided with needles of varying lengths which contain approximately the same amount of radium per centimetre of active length. *Fig.* 404, *b* shows one method of avoiding penetration of the lumen.

In other instances when puncture of the growth seems dangerous the needles can be stitched to the surface of the growth and the whole area covered with rubber tissue (*Fig.* 404, *a*).

The great disadvantage of the use of needles is the fact that they require to be removed, and that they entail a risk of peritonitis. The needles are inserted with the patient in the Trendelenburg position; the same position should also be adopted when they are pulled out. As a general rule they come away readily when the strings are pulled on, but occasionally it is both necessary and advisable to reopen the abdomen. In view of the fact that the radium sets up a mild peritonitis and results in a discharging sinus, the latter procedure is not without risk. At the present time the author employs rubber sheeting with Coffey's gauze-wick drains to pack off the radiated areas until the needles are removed, in order to avoid risks from leakage and the danger of adhesions to the small gut. If it can be shown that radiation with seeds can be made as efficient as with needles, there is no question that seeds should be preferred.

Ar the present time, in the author's experience, the best results with abdominal radiation have been secured with needles, which is no doubt due to the constant intensity as opposed to the diminishing intensity of the emanation. At the end of four days radon loses half its strength, and unless it is reinforced at this period there is a danger that the growth will be inhibited rather than destroyed. Immediate results with seeds have been promising at first, but have been incomplete or the patient has relapsed. No serious complication or fatal case, however, has followed intra-abdominal radiation of a tumour with seeds. When the growth is partly above and partly below the peritoneum the lower edge is dealt with by introducing seeds via the rectum. This may be carried out at the same sitting if seeds are used within the abdomen, but if needles have been employed it is advisable to wait until after their removal, as the lithotomy position required for intrarectal seeding may disturb the position of the needles.

The following case is the best result secured by abdominal radiation with needles :—

Case 2.—A postman, age 44, was admitted with an annular growth at the junction of pelvic and perineal portions of the rectum, which was fixed to the base of the bladder and to the sacrum. The abdomen was opened and the growth barraged with nine needles containing a total of 20·5 mgrm. left in position for 115 hours (2357 mgrm.-hrs.). The pelvic colon was fixed outside the abdomen in preparation for colostomy. The patient, however, with a liberal supply of paraffin, continued to evacuate his motions with comfort per anum after the radium was removed, so that the opening of the colostomy was postponed and in the end was never carried out. No replacement operation was performed, and the skin closed over spontaneously. The patient returned to work soon after discharge from hospital and has remained in uninterrupted good health since (now over two years).

Sigmoidoscopy shows a narrowed lumen, but no evidence of growth. The bowels act normally and regularly. The site of the original colostomy wound shows no evidence of hernia.

Vaginal Radiation.—As already stated, this route is made use of for growths which involve the anterior wall of the perineal portion of the rectum, in combination with exposure from behind and a posterior barrage, or with

abdominal radiation. The method may be employed by itself for an early anterior growth or be combined with intrarectal seeds, or in more advanced cases it may be combined with needling of the retrorectal space without exposure of the rectum (*Fig.* 405). This method is also of value as a palliative measure in advanced cases unsuited for surgical procedures. In one instance a rectovaginal fistula healed by this method and retrogression of the tumour made an excision possible and successful. In another case a rectovaginal fistula with recurrence of growth followed a local resection which had been carried out in the provinces. This was treated by vaginal radiation; the fistula closed and the recurrence cleared up, but three months later growth appeared above the original site of recurrence. Excision was carried out successfully. If a heavy dose of radium is employed through the vagina, it is advisable to protect the anterior wall with rubbered lead or a gauze pack, but in most instances this is unnecessary as it is difficult to burn the vaginal mucosa.

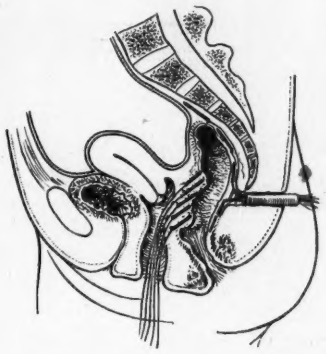

FIG. 405.—Vaginal radiation with perineal glandular barrage.

Intrarectal and Perirectal Radiation.—Three main routes of attack, from above, behind, and in front, have been described, and these may be regarded as the methods of choice. Direct attack via the lumen of the rectum has certain disadvantages unless the growth is quite small, when, as already stated, it may be possible to wipe out the growth without a colostomy and without subsequent disability. In a large growth access is difficult, uniform barrage almost impossible, and the lymphatic spread is not dealt with.

The poor results obtained with a central tube have been referred to. It is difficult to keep needles in position in the growth for an effective period. Hæmorrhage, sepsis, and risk of metastasis are necessary evils of the method.

If intrarectal treatment is considered advisable, seeds should be used. The author employs this method in certain early cases in which operation is refused or contra-indicated, in advanced cases when there is little hope of cure, for relief of troublesome symptoms, and as an accessory treatment to abdominal, perineal, or vaginal radiation. In an annular growth treated on palliative lines the seed introducer is passed deep to the growth to its upper limit and a seed introduced. The introducer is withdrawn 2 cm. and another seed introduced, and so on according to the length of the growth. For a uniform annular growth this is repeated round the clock at 2, 4, 6, 8, 10, and 12. Seeds of 1·5 mc. to 2·0 mc. (0·5 mm. filtration) are usually employed. A uniform annular growth involving 6 cm. of the ampulla of the rectum would thus receive 18 seeds.

It will depend on the position of the tumour whether the seeds are passed through puncture holes in the skin round the anus and directed by a finger in the rectum to the deep surface of the growth, or are passed through the lumen. The former is preferable, and suitable when the growth is low. If the growth involves the upper portion of the ampulla, the method just described is more easily carried out. In some cases intrarectal seeds have been

combined with needles passed through the skin into the perirectal tissues; this is advisable if an attempt is made to cure the case by this method (*see Fig.* 399).

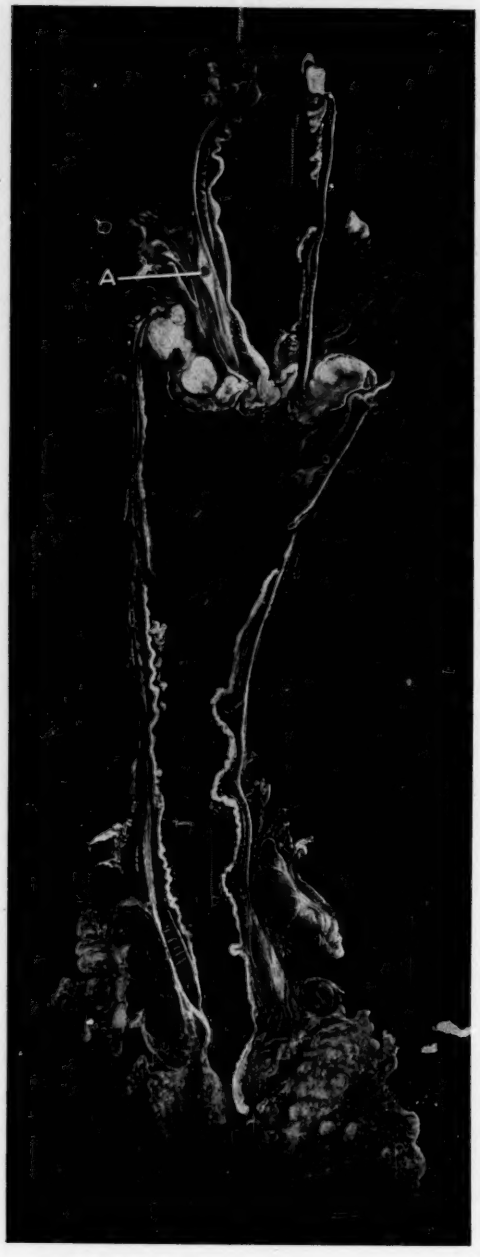

FIG. 406.—A specimen of carcinoma of the rectum excised following radiation with seeds. At A a seed is visible. Other seeds were found above the growth. Intussusception gave a false direction to the seed-introducer passed deep to the growth.

In anal carcinoma a combination of needles round the growth, and seeds into it, has been very successful. When the growth does not extend up the anal canal, surface application (combined with peripheral needling) may be an efficient and perhaps a superior substitute for seeds. If the glands in the inguinal region are involved, surgery followed by surface application is advisable. If there are no palpable glands, the lymphatic area may be treated by needles, seeds, or surface application. More experience is required before an opinion can be expressed as to the best method.

Radiation Prior to Excision.—There can be no doubt that in some instances an inoperable case can be rendered operable by the preliminary use of radium. In May, 1926, I used radium for a growth of the anterior half of the rectum which was adherent to the uterus and had perforated into the vagina. In February, 1927, the perforation had closed, the growth was much reduced in size and no longer fixed to the uterus, and the general condition of the patient had improved enormously. In March, 1927, I excised the rectum, and the patient is alive and well to-day.

In several instances I have employed radon seeds within the peritoneum at the time of colostomy prior to perineal excision for an operable growth. The seeds are inserted into the retrorectal space and along the line of the inferior mesenteric vessels. In two instances I have attacked an advanced inoperable growth with intrarectal radon seeds, and have found after some months' interval the general condition and the local condition so much improved that I have subsequently excised the rectum.

On several occasions when an attempt has been made to cure an operable case an incomplete disappearance of the growth has followed, and excision has been carried out at a later date. It might be expected that perirectal fibrosis and a diminished blood-supply resulting from radiation would increase the difficulty and impair the healing. Excision should not be delayed too long after radiation, so as to avoid the difficulties which may result from cicatricial contraction and adhesions. Up to the present the difficulties have not been noticeably increased, though healing after operation has been slower than usual. In the case referred to above, in which a rectovaginal fistula healed, the excision was exceptionally easy. There was complete atrophy of the levatores ani, which greatly facilitated the operation, and hæmorrhage was almost negligible owing to atrophy of the blood-vessels. Whatever may be the ultimate verdict on the value of rectal radiation there can be no doubt that the power to convert an inoperable into an operable growth opens up a useful field which should be fully explored. If radium is employed within the abdomen, it is unlikely that any abdominal excision will be possible at a later date, owing to the plastic inflammation which usually follows.

Fig. 406 illustrates a rectum excised by the author after radiation with seeds had been carried out at the Radium Institute by a member of the staff. The growth, though situated above the peritoneal reflexion, could be drawn down to the anus. In this position seeds were inserted. In view of the extreme mobility of the growth the patient was transferred to St. Mark's for excision, which was carried out three weeks later. No obvious changes were apparent in the growth, and it was noted that, in consequence of the invagination, many of the seeds which were still present were found some distance from the growth.

FIG. 407.—Excision after radiation. The smooth floor of the ulcer is partly covered by regenerating epithelium. The area of growth beneath shows marked mucoid degeneration. (*Author's case.*)

Fig. 407 illustrates a rectum excised five weeks after intra-abdominal radiation with seeds (10 × 2·5 mc.). At the operation for the introduction of radium and colostomy the growth was found to be definitely operable, and was excised later by the perineal method. It is instructive to note the changes which have occurred. Most of the growth has been converted into islands of mucoid degeneration, and the surface of the ulcer is covered by new epithelium which has grown over a granulating area. *Fig.* 408 is a microscopic section of the tumour, and shows the new epithelium very clearly, and *Fig.* 409 shows the changes in the intima of the superior hæmorrhoidal artery, along which seeds were passed.

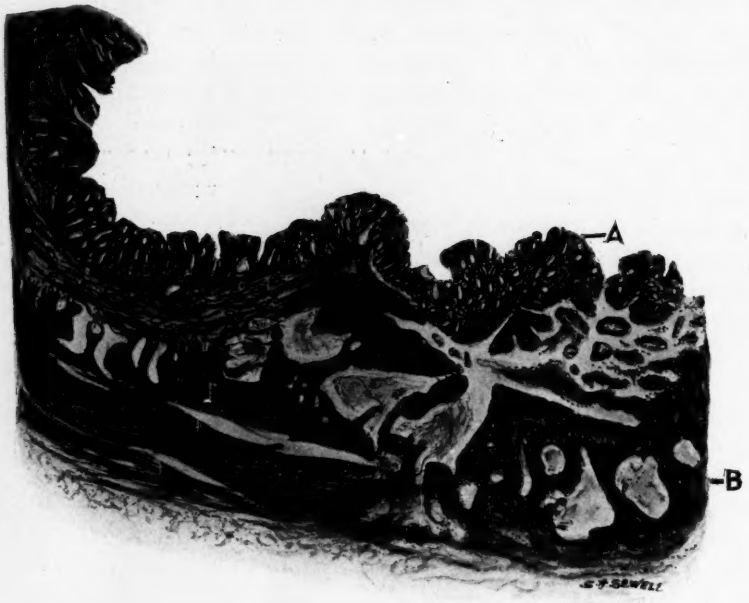

FIG. 408.—Microscopic section from *Fig.* 407. The section shows several collections of malignant cells in the submucosa and muscles, but the surface of the ulcer is covered with a thin layer of granulation tissue incorporating some healthy glands. These appearances are unknown in untreated cases, and indicate an attempt at healing and regeneration of the surface epithelium. A, Regenerated epithelium; B, Areas of mucoid degeneration.

FIG. 409.—Proliferative endarteritis in the superior hæmorrhoidal artery from a case (*Fig.* 407) in which excision was carried out thirty-three days after radiation with seeds inserted into the mesorectum and growth.

Fig. 410 shows at A a smooth healed surface, without cicatricial contraction, which has followed radiation of an early growth. Unfortunately a second malignant tumour higher up was discovered three months later, for which excision was carried out.

Recurrence Following Excision.—In the past a local recurrence of carcinoma following excision of the rectum has seldom been amenable to successful surgery. In some instances response to deep X-ray therapy has been recorded, but these results were of a temporary nature. Three cases have been treated with needles alone or combined with external radiation on Columbia paste. No case has been under observation long enough to enable one to express an opinion as to cure, but results so far have been much more encouraging than could have been anticipated. One of these cases may be cited :—

Case 3.—A patient came under observation two years after a perineal excision in India. Exploration of a discharging sinus revealed an extensive and diffuse infiltration of the scar tissue in the perineum. A portion of this tissue was removed and proved to be adenocarcinoma. The infiltrated area was given a heavy dose with needles and this was followed by intensive surface radiation with Columbia paste (total dose 14,000 mgrm.-hrs.). In spite of considerable delay in healing, and severe peripheral neuritis, which was undoubtedly due to an overdose, the patient returned to India a year later apparently cured of his recurrence.

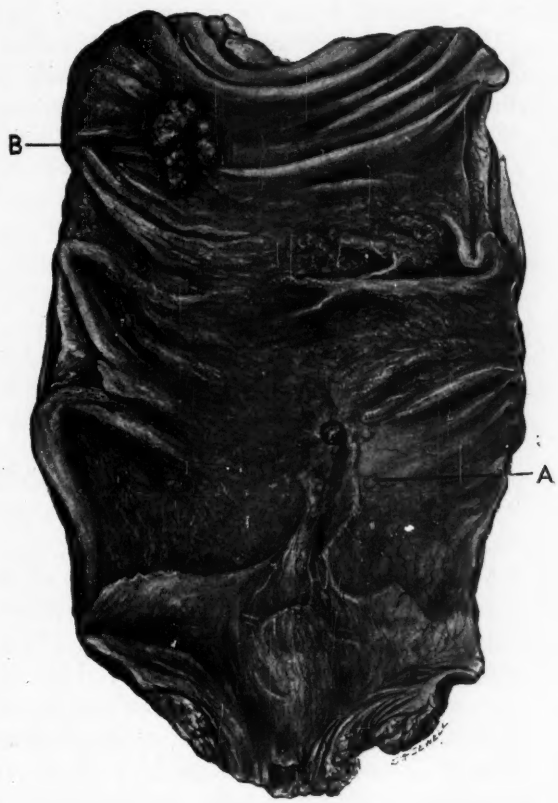

FIG. 410.—Results of radiation. Rectum excised for carcinoma shown at B. At A there is a puckered scar resulting from radiation of a carcinoma nearly three months before the second growth was discovered. No carcinoma could be discovered on section of tissues behind the scar. The small nodule at the upper end of the scar was quite soft. The growth treated was about 1½ in. in diameter. (*Mr. Gabriel's case.*)

Recurrence Following Radiation.—In all branches of surgical radiation it happens unfortunately that apparent cures relapse or that a tumour shrinks to small proportions and then resumes active growth. Such results no doubt will become less frequent with increased experience. So far as this present series of cases is concerned, a recurrence seems more likely to follow after the use of radium seeds than needles, and it appears probable that the diminishing intensity of radon, as opposed to the constant intensity of radium, is the causal factor. It may be possible to overcome the factor of diminishing intensity by reinforcement—that is, by supplying additional radon at short intervals, which can be done in certain situations,

especially when general anæsthesia is not required. Another method which the author has tried is to combine intrarectal seeds with perirectal needles, a method which minimizes the loss of intensity, though it does not give a uniform intensity. In several instances, when retrogression of the tumour has appeared to be complete (or nearly so) and recrudescence has followed, radiation has been repeated (in a few cases more than once), but in no instance has the result been entirely satisfactory. These remarks do not apply to those cases which have been treated by intra-abdominal radiation followed by intrarectal radon seeds, some of which are still under favourable observation. Without doubt primary radiation increases radio-resistance to secondary radiation, and further, in the author's experience, secondary radiation often produces considerable pain of a type which suggests a neuritis and appears to involve the sacral plexus. In the light of present experience, excision when possible must be recommended when radium fails at the first count.

With inoperable cases it is worth while to persevere, provided that marked improvement for a period follows initial treatment. It is in this type of case that secondary treatment with the intrarectal 50-mgrm. tube may be found useful, if not used too soon after the primary treatment. Some cases of this type have been treated by deep X-ray therapy after radiation and no marked improvement has followed. It would, however, be unwise to report unfavourably on the value of deep X rays after radium, as the method has not yet been given a fair trial. So far as experience goes at present, deep X-ray therapy seems to be of more use before than after radium.

Relapses following apparent success are so frequent that it is evident some improvement in technique is required, and it is essential to explore to the full the combination of interstitial radium therapy with deep X-ray therapy, and with telecurietherapy when it becomes possible.

RESULTS.

This paper is based on the experience gained with the treatment of 93 cases of cancer of the rectum with radium during the past five years up to the end of 1929. Many of the cases are so recent that any assessment of results on a statistical basis at the present time would prove fallacious. In certain instances it has been demonstrated: (1) That an early growth on the anterior wall of the rectum can be destroyed by needling through the vagina, and that the rectum at the site of growth can be restored to its normal appearance and calibre; (2) That a similar result can be secured by introduction of seeds directly into a small growth without colostomy; (3) That a large fixed inoperable growth can be destroyed by perineal radiation, with a resultant fibrous stricture, and remain well (four years); (4) That an inoperable high growth can be apparently cured by abdominal radiation and remain well (two years), and further that a colostomy is not always essential; (5) That a fixed inoperable growth can be rendered operable; (6) That a perineal recurrence can be made to disappear; (7) That the worst and most advanced cases can be made more comfortable by relief of symptoms.

It is true that the successful cases form a small percentage of the total, but the fact that radium can accomplish these results is a great encouragement to persevere.

With perhaps the exception of the œsophagus, no branch of radium therapy which is practised to-day presents greater difficulty of access. Many other difficulties arise, especially with regard to uniform distribution, lymphatic spread, sepsis, bladder complications, and adequate observation of the progress of the case, and it is not surprising that some workers with much experience of radium have abandoned the pursuit and are content to write off carcinoma of the rectum as radio-resistant.

It is quite certain, if brilliant successes can be secured in a small percentage of cases, that increased experience must reduce the failures and add to the successes, though difficulties will always remain which are sometimes insurmountable.

To secure a low mortality for excision of the rectum—that is, lower than the average—calls for either a careful selection of cases, or experience and skill above the average. Time will show whether a combination of these three factors will vastly improve results in radium therapy in all its branches, or will reveal that radium is too capricious a master and too little a servant to be reckoned with as a serious fighting factor in the campaign against cancer.

Until we are in a position to measure the action of radium with some accuracy, to be able to say with confidence that a given dose of radium administered in a given way for a given time will produce a certain result, we are, I think, in duty bound to advise surgery, mutilating though it is, in preference to radium for the operable case. Where, however, as sometimes happens, the growth is operable, but the patient is considered unsuitable for radical surgery on other grounds, then I believe radium holds out great though uncertain, prospects of cure, and should always be employed when available.

When passing in review the results of my work with radium during the past five years I do not doubt that, with increasing experience, we shall be able to cure, year by year, a higher though small percentage of inoperable cases which can be cured in no other way, and I am satisfied that with judicious selection of cases we can assist those who have passed beyond the prospect of cure, by giving them hope, by alleviating their symptoms, and by prolonging their lives, even though in some instances our best efforts result in complete failure.

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CONGENITAL NON-ROTATION OF THE INTESTINE.

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The present case was that of a girl, age 8 years, who since birth had suffered from attacks of what had been called gastritis. These attacks had occurred at approximately six months' intervals. The symptoms during the attacks had been: (1) Epigastric pain on the right side of the mid-line; this was intermittent, and did not seem severe. (2) Vomiting, which was not obstructive; the vomit consisted of ingested food, and was not bile-stained; the vomiting was not continuous, but occasional. (3) Malaise. The attacks lasted three to seven days, subsiding gradually. For the improvement credit was given to powders prescribed by the patient's doctor. In the intervals the bowels were quite regular, there was no indigestion, and the appetite was good. In spite of a good appetite, however, the child did not thrive.

The first of the attacks occurred three days after birth, and lasted till the seventh day. The child vomited all her feeds. There was no bile in the vomit. The final attack, which terminated fatally, commenced a week before the patient's death in the usual way, but gradually became more severe during the first four days. Constipation was absolute, no fæces or flatus being passed during this time. On the fourth day the patient's pulse was rapid and her face flushed. She complained of severe pain in the epigastrium and right hypochondrium. On examination there was intermittent rigidity in the right hypochondrium, but no definite tenderness, i.e., pain was not increased by palpation. There were no localizing signs in the abdomen. An enema was administered with a poor result. Vomiting continued, and was greater in quantity than the fluid taken by the mouth. On the fifth day the vomit became bile-stained and copious. On the sixth day the pulse was very rapid and thready, and the vomit became thick and dark coloured; it was the vomit of high intestinal obstruction. The patient was too ill for surgical interference. She died on the seventh day.

Autopsy Findings.—The liver was normal, the gall-bladder slightly distended. The first part of the duodenum was also distended, the second part descended obliquely, with a slight inclination from right to left, crossing the mid-part of the transverse colon, while the remainder of the duodenum was twisted and constricted at the volvulus of the mesentery. The cæcum was in the right iliac fossa, but its posterior surface with the appendical junction was anterior. The left half of the transverse colon was normal in colour, while the right half, the ascending colon, the cæcum, the appendix, and the whole of the small gut were intensely congested. There was a considerable constriction at the mid-point of the transverse colon, where the duodenum crossed it. The cæcum and ascending colon were freely movable.

By rotating the gut involved in the twist in an anti-clockwise direction, through an angle of 180°, the volvulus was undone. The cæcum was then in the left iliac fossa, with its appendix junction posteriorly. The ascending colon passed up from this on the left side of the vertebral column, and with the right half of the transverse colon formed a loop whose concavity was on the left side. The terminal part of the ileum passed from right to left to join the cæcum. The lower part of the duodenum and right half of the transverse colon lay close together. The superior mesenteric artery passed down on the left side of the duodenum and on the right side of the constriction in the transverse colon. At this point the transverse colon passed through a tunnel of the mesentery.

The omentum on the left side was attached, as usual, to the stomach and transverse colon, but further to the right it was attached to the mesentery

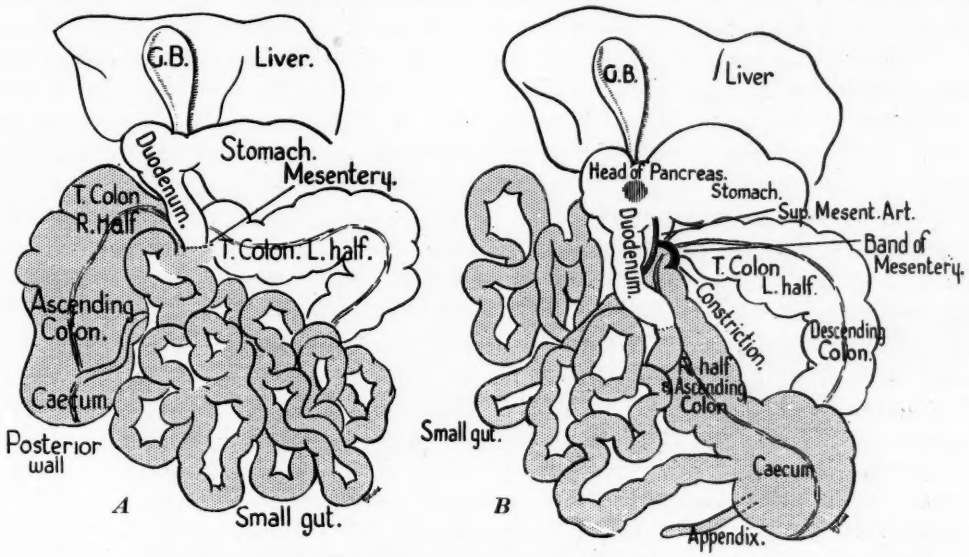

FIG. 411.—Congenital non-rotation of the intestine. *A*, With volvulus ; *B*, Volvulus untwisted. The shaded area shows the congested portion of the bowel.

at its fixed point, to the right side of the duodenum, and to the front of the right kidney. The cæcum with the appendix, the ascending colon, the right half of the transverse colon, and the whole of the small intestine were suspended by a common mesentery which had a comparatively short attachment to the posterior abdominal wall high up. This attachment was transverse with a slight inclination downwards and to the right; on the right side the attachment was to the anterior surface of the right kidney. This segment of the gut corresponds to the congenital mid-gut. The gut was narrowed at two places, in the lower part of the duodenum, and in the middle of the transverse colon. Through a volvulus of the 'mid-gut', its mesentery had been twisted through an angle of 180°, causing venous engorgement and complete duodenal obstruction. (*Fig.* 411.)

Other Reported Cases of Anomalies of Intestinal Rotation.—A similar case is reported by Norman M. Dott[1] in a baby in whom the symptoms made

their appearance on the fifth day after birth. In that case there was acute obstruction in the lower part of the duodenum. Dott also quotes two cases from the French literature. In the case under discussion obstruction became complete only toward the end of the terminal attack.

Dott discusses the whole question of anomalies of intestinal rotation in their embryological and surgical aspects, and states that in infants with such anomalies extensive volvulus with acute duodenal obstruction may be met with. The child is normal when born, remains so for some days, meconium is passed, and if the onset of volvulus has allowed time, food residues appear in the motions on the third or fourth day. Vomiting begins early, and occurs in relation to food. The vomit is soon deeply stained with bile. In later stages there is gastric dilatation and erosion. Gastric peristalsis may be observed. The upper half of the abdomen becomes distended (stomach and duodenum); the lower half is recessed from collapse of the intestine. The degree of constipation varies with the degree of obstruction.

In the case at present reported the child was 8 years old; she had had many attacks of 'gastritis', which in all probability were due to partial volvulus of the mesentery with its very short attachment. Not until the final attack was the twist sufficiently severe (180°) to cause mesenteric engorgement to an extreme degree, and duodenal obstruction.

G. E. Waugh[2] records five cases of congenital malformation of the mesentery which had come under his own notice, none of which, however, was similar to the case under discussion. Four of these cases he diagnosed before operation. He says that the pain the patients suffered was characterized by its 'unusualness', that the vomiting was erratic and rare except in one case, and that in four cases out of five there was an asymmetrical fullness of the abdomen, the right iliac fossa being empty. The symptom complexes, Waugh says, cannot be explained by reference to any of the well-known surgical diseases. The ages of the patients were $6\frac{1}{2}$, 12, 10, 21, and $7\frac{1}{2}$. Radiological examination did not afford help except in the last case of the five, where, after the bismuth meal had entered the small intestine, as observed by screening, a barium enema was also given. Waugh advises this procedure.

It is noticeable that the patient under discussion had her first attack when only a few days old, as in the case reported by Dott, but lived for eight years with recurring attacks, to succumb finally from a twist of her mesentery that brought about acute congestion of her mesenteric veins and obstruction of her duodenum.

[NOTE.—It has been suggested that the case above reported is one of 'reversed rotation' rather than of 'non-rotation'. In the writer's opinion, it is a case of non-rotation that by volvulus has become one of reversed rotation. The anatomical findings fit in with this conception.]

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FAT NECROSIS OF THE BREAST.

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INTRODUCTION.

THE commendable modern practice of radically excising any new formation bearing a reasonable clinical likeness to malignant disease in a patient of the cancer age has brought into some prominence, and provided examples of, an innocent lesion of the breast presenting itself most often in women between the fourth and fifth decades, frequently as a stony-hard tumour firmly fixed to the skin, often resembling an early cancer so closely that a wide resection of the breast has been performed. In a few cases a similar lesion has appeared in relation to the scar following breast amputation for cancer, and the likeness to recurrent growth has been equally deceptive.

The lesion in the majority of cases is a relatively small mass of traumatized subcutaneous fat undergoing quiet and usually painless sterile autolysis or heterolysis whose bulk is added to by the accumulation in it of phagocytes engaged in the absorption of fatty acid and fibroblasts initiating repair. Eventually the lesion cicatrizes and any unabsorbed fat and saponification products become enclosed in mature fibrous tissue. A thick-walled cyst containing dark fluid results, and calcification is frequent in the late stages.

The central feature of the process is slow aseptic saponification of neutral fat by blood and tissue lipase analogous to pancreatic fat necrosis, but much milder in degree and independent of any direct action of pancreatic lipase.

The lesion arouses suspicion chiefly by reason of its situation in the fat overlying the breast, and copies the physical signs of cancer most closely in the early and middle stages of its evolution, when it is usually stony hard. At no stage does its naked-eye appearance on incision or its microscopic characters bear a close resemblance to cancer, but its histology may conceivably suggest tuberculosis.

As a naturally occurring pathological process, extraperitoneal fat necrosis was described by Shattock[1] in 1896 in a lipoma of the thigh. In the same number of the *Transactions of the Pathological Society of London* is an article by Targett[2] describing a similar lesion in a lipoma of the breast. They called the lesion 'saponifying necrosis'. Lanz,[3] of Berne, in 1898 described an identical lesion in subcutaneous fat as 'traumatic fatty necrosis', indicating its frequent association with injury. Heyde[4] in 1911 described it in the fat of the thigh, and quoted two other cases. Küttner[5] in the same year described it in abdominal and extra-abdominal fat, but it was left to Lee and Adair[6]

in three publications between 1920 and 1924 to draw attention to the fact that when fat necrosis affects the cellulo-adipose tissue over or in the breast, the lesion may be extremely difficult to distinguish from early cancer. Amongst their conclusions are: (1) "Traumatic fat necrosis of the breast is a definite clinical entity." (2) "It must always be included with the benign lesions of the breast." (3) "Clinically it more closely resembles carcinoma of the breast than any other tumour." (4) "A distinct history of trauma to the breast and a well circumscribed mass showing rapid increase in size, unassociated with pain and without axillary nodes that are firm, suggest the possibility of fat necrosis." (5) "The diagnosis of traumatic fat necrosis of the breast by gross examination is possible." The gross features of the lesion should therefore be clearly understood by every surgeon.

Further observations have amply confirmed most of these findings. It appears, however, that the importance of the traumatic factor was overstated by Lee and Adair, and not enough stress laid on the fact that in quite a fair percentage of cases the clinical resemblance to cancer is superficial and unlikely to lead to excision. Farr[7] in 1923 described a similar lesion in the subcutaneous tissue of young infants probably due to birth injury, and published instructive experiments on the mechanism of sterile *in vitro* lipolysis. He produced the lesion in young pigs by pinching the skin and subcutaneous tissue with forceps. From 1923 up to the present time further information has been supplied by Gottesman and Zemansky[8] from America, by Roffo[7] from the Argentine, by Stultz, Diss, and Fontaine,[10] and by Lecène and Moulonguet,[11] from France, and by Keynes,[12] Hadfield,[13] and Moir[14] from Great Britain.

It would be misleading in the introduction to this paper if some attempt were not made to place the subject of extra-pancreatic fat necrosis in its proper perspective from a purely pathological point of view. That traumatized or ischæmic fat in any situation in the body can and often does undergo quiet sterile autolysis or heterolysis, resulting in saponification, and the phagocytosis of chemical products of saponification by histiocytes and giant cells, is a well-established general principle in the pathology of repair.

Shattock's account written in 1896 of the changes found in his case of 'saponifying necrosis in a lipoma of the thigh' is an exact description of the two phases in the evolution of 'fat necrosis' as seen in the breast. He saw "an opaque white necrotic area in the centre of the lesion and near by another focus in which softening had taken place with the production of a pseudo-cyst". He remarks that "the oil in the cells undergoes saponification, combinations taking place between the fatty acids and the lime and soda salts of the plasma which infiltrates the dying tissue", and that "a few cells hold the delicate radiating crystals of solidified fat, while others are filled with a crystalline coarsely fissured substance".

M. J. Stewart has fully described this and similar tissue reactions to fat, lipoid, and saponification products in several papers in which the uniformity of cell response to these substances in many situations is clearly demonstrated. For example, fat necrosis often affects adherent extraperitoneal fat in the sacs of herniæ, and the identical nature of the lesion to that occurring in the breast can be easily demonstrated.

Fat necrosis of the breast is therefore by no means unique as a pathological process; its importance lies in its liability, purely due to situation, to mimic the clinical signs of mammary cancer. This being so, it is imperative that its naked-eye appearance and microscopic characters be well established.

CASE REPORTS.

Case 1.—Mrs. M., age 45, with eight children alive and well, has had a lump in the right breast for the last two and a half months. She has had pain off and on in this breast for fifteen months, dating from a week or so after lactation and persisting throughout the whole period of eight months. At first, on putting the child to the breast, the gland became full, tense, and painful, but no lump was noticed. The tenseness subsided in about ten days, but the pain continued off and on during the rest of lactation. She weaned the child after eight months, and for the next four months, during which there was amenorrhœa, there was no pain, swelling, or lump. When menstruation recommenced and at the end of the first period the pain was again noticed, and continued monthly, but until two and a half months ago no lump was noticed. There has been no discharge from the nipple except on one occasion, when there was slight serous discharge lasting one day. Since the lump has appeared it seems to vary in size, is sometimes large and soft, at other times smooth and 'very hard'.

Clinical Examination.—The patient is well-covered, but not obese. The breasts themselves are not unduly fat. In the upper lateral quadrant of the right breast there is a hard, somewhat craggy mass the size of a bantam's egg, not tender on touch or manipulation. The skin over the tumour is adherent to it and shows the *peau d'orange* appearance. The lump is fixed to underlying tissues, but not very firmly. Several rather hard glands were felt in the right axilla, none in the left. There was no nipple retraction. Early cancer of the breast was diagnosed and a radical excision performed.

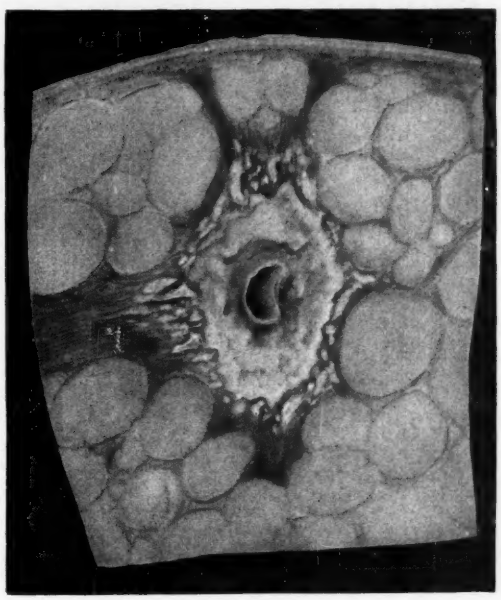

Fig. 412.—*Case* 1. Chalky-white mass with central area of liquefaction. Many small chalky particles lying in peripheral fibrous tissue. ($\times \frac{3}{4}$.)

Comments on Clinical History.—The lump was noticed only two and a half months before operation, and the pain during lactation was not localized. There was no history of precise trauma, the patient was not very obese, nor were the breasts pendulous. The skin was not ecchymotic over the lesion. There is therefore no clear connection with trauma or with lactation. For these reasons, and in view of the fact that the breasts were not very heavily laden with fat, a pre-operative diagnosis of anything but carcinoma in this case would have been unjustified.

Pathological Examination.—The hard mass felt in the upper lateral quadrant was lying 4 to 5 cm. below the skin, was roughly ovoid with rather ill-defined boundaries, and measured 5 cm. by 4 cm. in its principal diameters. On section it was found to be lying outside the mammary gland proper, but firmly attached to its axillary prolongation. The central part was cystic, and contained yellowish-brown fluid, greasy débris, and small chalky-white particles. Around the cyst was

FIG. 413.—*Case* 1. Low magnification of section of lesion. Central cavity surrounded by compact wall of autolysing fat and phagocytes. Normal fat below and to the left. Breast tissue above and to the right.

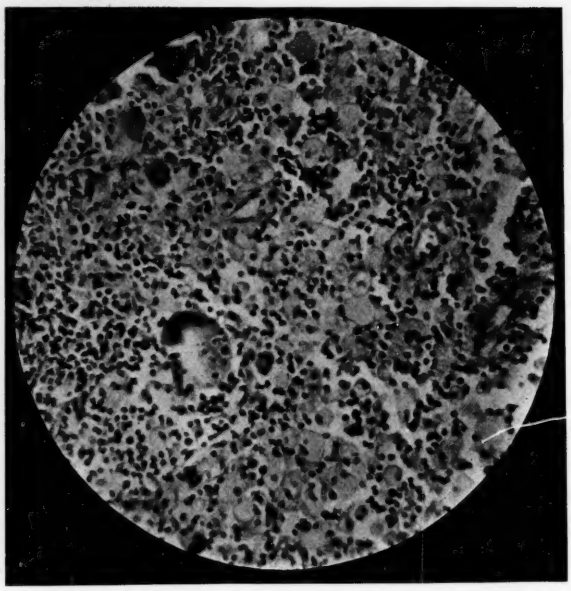

FIG. 414.—*Case* 1. Section of autolysing fat surrounding central cavity. Many large fat phagocytes with small nuclei. Rich infiltration by lymphocytes.

a thick prominent zone of opaque chalky-white tissue surrounded by an irregularly-contracting pinkish zone containing many isolated irregular white chalky masses resembling that surrounding the central cyst (*Fig.* 412). The mammary gland itself appeared normal. No glands were found in the axillary fat.

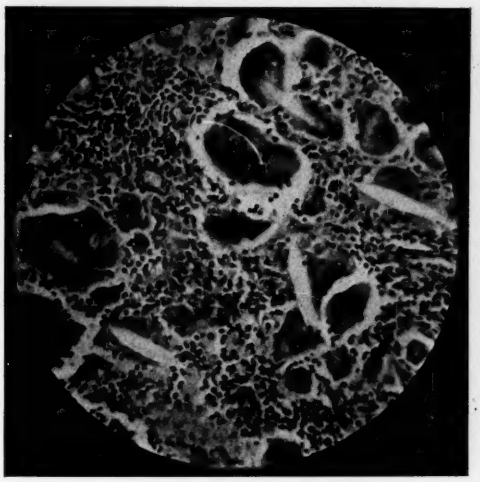

FIG. 415.—*Case* 1. Field showing cigar-shaped clefts previously occupied by saponification products, lined by foreign-body giant cells.

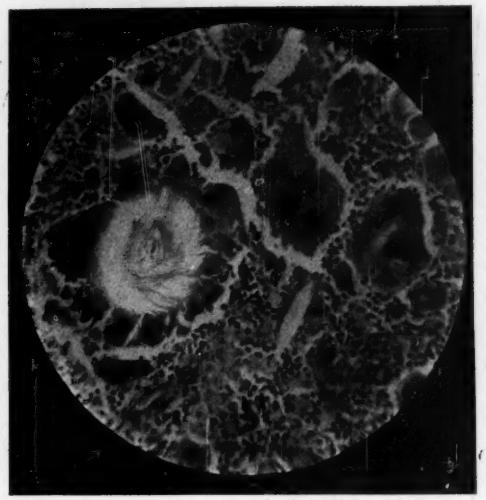

FIG. 416.—*Case* 1. Mass of fatty acid crystals surrounded by multinucleated giant cells.

Histologically, the 'cyst' was found to be an unlined cavity lying in the centre of a cellular mass irregularly invaded by peripheral fibrosis (*Fig.* 413). The central part of the mass was almost avascular and crowded with large mononuclear phagocytes distended with fat in fine emulsion, multinucleate giant cells containing coarse isotropic crystals having the physical properties and giving the staining reaction of fatty acid, and small more delicate crystalline masses staining deep violet with Nile-blue sulphate, but becoming partly homogenized at 45° C. These masses were in all cases completely enclosed in a wall of large multinucleate giant cells (*Figs.* 414–417). Towards the periphery the lesion was fairly densely infiltrated by plasma cells and lymphocytes, with a moderate number of polynuclear leucocytes at one part, and many fibroblasts towards the edge, where there were many young capillary vessels.

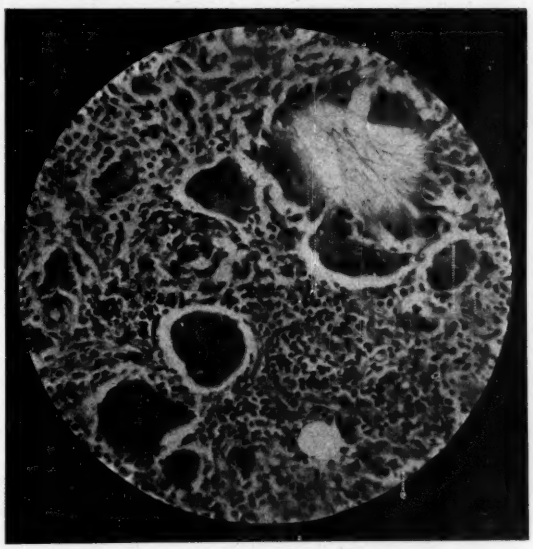

FIG. 417.—*Case* 1.—Similar giant cell to that seen in *Fig.* 416.

Case 2.—The patient, age 41, had noticed a lump in the left breast for one month. It was slightly tender but not painful. There was no history of local trauma to the breast or general trauma involving that side of the chest.

FIG. 418.—*Case* 2. Early fat necrosis. Low magnification of whole lesion. Central area of liquefaction with breast lobules peripheral to it. Microphotographs taken from the tissue lining the lower half of the liquefaction cyst.

CLINICAL EXAMINATION.—The patient is thin but healthy. The affected breast is small and nodular, and the tumour, which lies in the upper lateral quadrant, is cystic, the size of a small hen's egg, not attached to the skin or muscle, and there is no retraction of the nipple. One soft gland was felt in the axilla. There was no ecchymosis of the skin. Local excision of the tumour was performed.

Comments on Clinical History.—Again there is no history of localized trauma. Carcinoma was not considered, as the lesion was well away from the gland and cystic.

PATHOLOGICAL EXAMINATION.—A small cystic mass was found lying 3 cm. below the skin well away from the body of the mammary gland. It was ill-defined, and measured 3 cm. by 1 cm., the long axis being parallel to the skin. The cyst was an unlined central cavity containing oily fluid and surrounded by a thin, opaque, whitish-yellow zone, fading into a pinkish, poorly defined peripheral area (*Fig.* 418).

Histologically the tissue at the edge of the central cavity was composed of closely packed mononuclear phagocytes crowded with fat droplets (*Fig.* 419). Towards the edge these were accompanied by many young fibroblasts, which were numerous at the periphery,

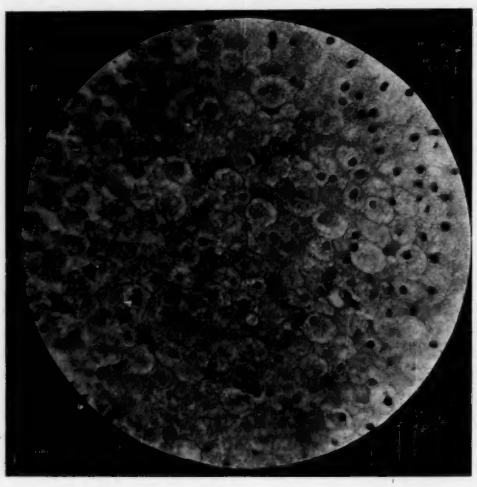

FIG. 419.—*Case* 2. Field showing phagocytic cells filled with finely emulsified neutral fat.

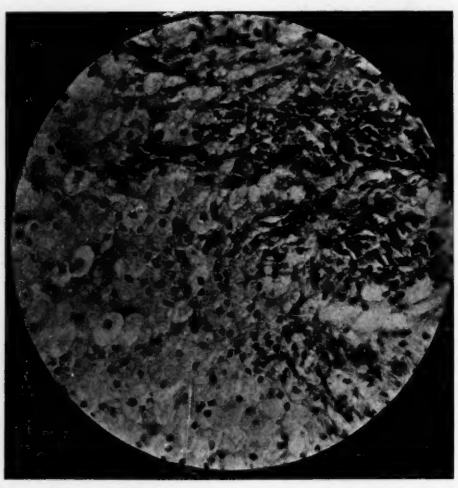

FIG. 420.—*Case* 2. A similar field showing invasion of phagocytic zone by fibroblasts.

where they resembled a tissue culture of these cells (*Fig.* 420). Fatty acid crystals and multinucleate giant cells were absent. The contents of the central cavity were acellular and stained rose to lilac with Nile blue. The cellular zone at the edge stained mauve to violet.

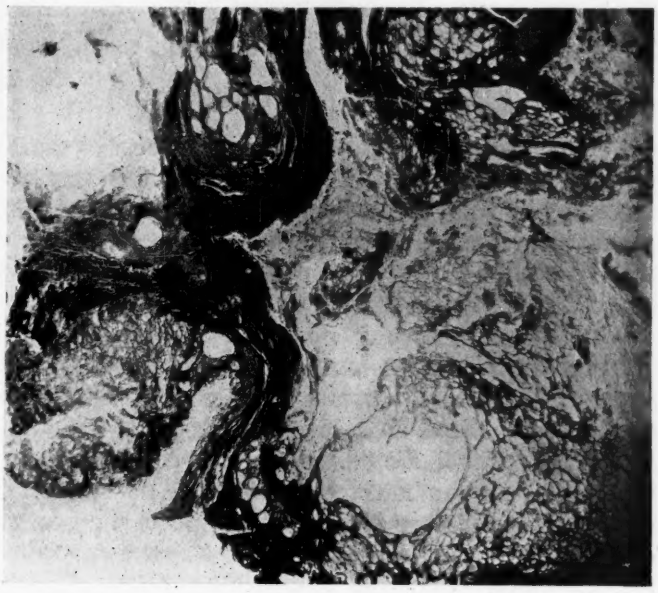

FIG. 421.—*Case* 3. Fat necrosis simulating recurrent cancer. Low magnification of about one-third of the whole lesion. Multilocular cyst, walls of mature fibrous tissue lined on inside by phagocytic cells, many multinucleated and containing oily débris.

Case 3.—The patient, age 57, had a complete excision of the breast performed for a small carcinoma growing in the upper lateral quadrant. The diagnosis was confirmed microscopically. No glands were found in the axillary fat. The wound healed by first intention except for a small length in its lower and inner portion; this part healed by granulation without incident in about three weeks.

She noticed pain and indefinite swelling in the upper part of the wound about 1½ cm. from the anterior fold of the axilla nine weeks after the operation, but did not report it until twelve weeks after operation. A hard mass was then found about the size of a cherry, its centre 1¾ in. below the clavicle, its lower limit reaching the healed operation wound. It was firmly fixed to the skin and to the deep tissues. Indefinite fluctuation was felt. There was no other lump in the skin; the axilla was empty. Recurrent growth was confidently diagnosed and a wide excision was carried out.

FIG. 422.—*Case* 3. Mass of multinucleated giant cells composing wall of one of the cystic spaces.

PATHOLOGICAL EXAMINATION.—The lesion was well defined, measured 5 cm. by 4 cm. in its principal axes, and consisted of a central cavity with ragged edges and brownish oily contents, completely enclosed in a thick fibrous wall. The cavity was divided into three unequally sized compartments by a broad branched band of fibrous tissue (*Fig.* 421).

Microscopically, the contents of the cavity were acellular and fatty, the wall lined on its inner surface by a cellular layer varying considerably in thickness and composed of large numbers of multinucleate giant cells, the majority containing fat in fine emulsion (*Fig.* 422),

a few containing a very fine feathery crystalline deposit which did not stain satisfactorily with Nile blue and was not doubly refractile, but melted at 45° C. These crystals were taken to be neutral fat. The cellular zone was irregularly invaded by fibroblasts. The capsule was composed of mature fibrous tissue.

DISCUSSION.

I have been able to find 42 fully recorded cases of necrosis of the fat over or in the breast with the production of a tumour: these with the 3 cases recorded in this paper bring the total number to 45. The large majority occurred in the fourth and fifth decades in married women. The average age was 50; only 12 per cent of the cases were under 40; one is reported at the age of 19. There appears to be no constant association with lactation: in several cases there was no history of lactation; in the majority it was a remote event. In at least 40 per cent there was a clear history of rather severe trauma to the breast; in many of these there was considerable ecchymosis at the time, and in all of them, apparently, the tumour arose where the injury was inflicted. In one group of cases reported the trauma was inflicted during subcutaneous infusion by saline. In Lee and Adair's series of 20 cases a history of severe trauma was present in 70 per cent. They lay stress on the fact that the site of the tumour and the location of the injury are identical. In cases reported by other observers this history of precise trauma was less frequently obtained.

In cases where no traumatic history could be elicited, the site of the tumour appears to have been much more frequently in the upper and outer quadrant of the breast than elsewhere. The history of duration of the tumour varies from two years to ten days, but in the large majority of cases the lump had been noticed for two and a half months before seeking advice, and a history of progressive increase in size of the mass is common. Pain was complained of in the minority of cases, and tenderness in some, but neither pain nor tenderness is a common feature. There is no history of discharge from the nipple. Lee and Adair laid great stress in their papers on general obesity, and especially a fatty, pendulous, or projecting breast, as being present in the majority of cases. Judging by accounts of cases reported since theirs, this conclusion appears to have been justified, but, as Gottesman and Zemansky point out, the condition may occur in thin women.

The extent to which fat necrosis may mimic the clinical signs of cancer may be judged from the fact that of 45 collected cases, 12 (26 per cent) have had a radical excision of the breast, pectoral muscles, and axillary contents performed. The history of progressive increase in size may suggest cancer, and the clinical characters of the growth fairly frequently confirm it. In 66 per cent of the cases the mass is described as 'stony hard', 'as hard as a scirrhus', or as 'very hard', etc. In the remainder it is usually described as 'firm'; in a few cases as being 'firm with an area of fluctuation'; in one case as having ulcerated through the skin. The size of the tumour, as felt through the skin, varies from a diameter of 7 cm. to $1\frac{1}{2}$ cm. or is described as being the size of a bantam's egg, a lime, a tangerine, a large bean, a large pea, etc.

In at least 52 per cent the mass is noted as being adherent to the skin,

and in these cases the skin is fairly frequently described as showing the *peau d'orange* appearance. In only 10 per cent of cases at the most was there retraction of the nipple, and in about the same proportion the tumour was fixed to the deep tissues. When enlarged axillary glands were reported as being present, they were usually described as 'soft'. The tumour was generally described as being well-defined on palpation, but in at least 20 per cent of cases as being diffuse. It seems that if seen at a very early or a very late stage, it tends to appear diffuse, but in the intermediate stage of its evolution —that is, about two to four months after its appearance—it is usually well-defined, but hardly so well-defined as carcinoma. The naked-eye appearance of the lesion on section varies considerably, but at no stage is it likely that an experienced observer could mistake it for mammary cancer. The earliest lesions up to a fortnight in duration are often seen to occupy exactly one or two fat lobules, the outlines of which can easily be traced. These lobules in normal breast fat are usually ovoid and measure from $\frac{1}{2}$ to 2 cm. and from $\frac{1}{4}$ to 1 cm. in their principal axes, and early lesions vary in size from $\frac{1}{2}$ cm. by $\frac{1}{4}$ cm. to 4 cm. by 2 cm. At this stage the lesion is strikingly opaque, white, and dull, especially if lying surrounded by yellow fat lobules; the periphery of the lesion is pinkish. The colour may be whitish-yellow or xanthoma-like, but is much paler than the fat.

In early lesions the lack of cicatrization makes it easy to recognize that it is lobular in size, shape, and distribution; but even in these there may be central liquefaction, with the production of a pool of yellowish oily fluid. Very soon the lesion grows more chalky in appearance, and as it becomes invaded by peripheral fibrous tissue the unbroken central chalky area is split up, the edge becomes irregular, the lobular configuration is lost, and the appearance is that of many minute rounded and irregular fragments rather like candle grease in appearance, lying in pinkish connective tissue. At this stage there is usually some central liquefaction, or not infrequently a relatively large pseudo-cyst develops. The fluid in the cavity may be yellow and oily. It is often brownish in cases with a history of considerable and precise trauma. From this stage the appearance is altered by the slow development of a fibrous-tissue capsule, by cicatrization, and more extensive cyst formation, but the small fragments of white or whitish-yellow necrotic fat resembling candle fat remain in the lesion for several months at least.

At all stages the lesion feels firm to the touch, but it has never the hardness of scirrhous cancer when cut across, is never quite so well defined, and the areas of white or yellow opacity in it are larger, more irregular in shape, and do not radiate from the centre of the lesion in the manner of the fatty streaks seen so frequently in mammary cancers. In addition there is not the same tendency for the tumour to appear concave on section or for the rich development of pink translucent bands of fibrous tissue which are seen in scirrhous carcinoma. In some cases the lesion is irregularly and lightly pigmented by hæmosiderin deposit. In old cases there is irregular calcification, and the lesion is usually cystic.

Neutral fat can be demonstrated in the lesion in most cases of fat necrosis of the breast, and in the early ones in fairly large amounts mixed with fatty acid. The lipolysis is slow and incomplete, and, considering the amount of

tissue destruction, the peripheral inflammation is mild. There can be little doubt that there is no infective factor. In pancreatic fat necrosis all neutral fat is rapidly transformed into soap and fatty acid, and in all probability the rapidity of tissue destruction is aided by trypsin proteolysis. Compared with the lesion in the fat of the breast, fat necrosis of the pancreas is, as expressed by Lecène and Moulonguet, "une phénomène massif et très brutal,—une saponification complète,—une véritable cadaverisation."

The amount of free lipoid in the lesion described in the paper, as judged by examination through crossed Nicols, was negligible, and the crystalline deposits surrounded by foreign-body giant cells were usually demonstrated as being fatty acid.

When the lesion occurs in the fat immediately under the skin over the breast it is very unlikely to suggest cancer, and Lee and Adair classify the condition into two groups, those occurring in the fat of the gland itself and those occurring in the fat overlying it. Gottesman and Zemansky describe it as being formed in the fat overlying the breast, as a single tumour in an otherwise normal breast, as multiple punctate areas in a breast the seat of some other pathological process, or in a lipoma of the breast. Their third group is difficult to accept as being precisely the same lesion as the others, for many such lesions originate from duct obstruction and the fat is derived from the secretion of the gland. The tissue reaction is undoubtedly similar.

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NOTES ON MALIGNANT TUMOURS.*

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A STUDY of the clinical histories and pathological changes occurring in 700 patients suffering from malignant tumours who were admitted as in-patients into St. Giles's Hospital during a period of just over five years, form the data for this article. All but thirty of these patients were found to have malignant tumours originating in epithelial structures; and as a result of these investigations, aided by a study of over 160 post-mortem examinations, certain facts bearing on the problem of carcinoma were ascertained. Three factors in particular were found to play an important part in the diagnosis, pathology, and treatment of malignant tumours:—

1. The first factor consisted of the *mechanical* changes associated with the proliferation of the tumour cells; and the resulting strictures of hollow organs or pressure effects on neighbouring structures led to complex changes in the body, but were frequently amenable to simple surgical procedures.

2. The second factor consisted of the *infective* changes which occurred directly or indirectly as a result of the activity of the tumour cells. This factor was considered to be of the utmost importance in malignant disease, and was responsible for a large proportion of the deaths which occurred in this series of cases.

3. The third factor was the property of *dissemination* which is a characteristic of malignant cells, and which may result in widespread metastases and give rise to puzzling clinical pictures as well as lead to disappointment in the results of treatment.

The 700 patients have been classed into eight sections: (1) 71 who had the primary tumour situated above the level of the larynx; (2) 22 with carcinoma of the larynx; (3) 8 having primary growths of the lung, and 8 with primary growths originating in mediastinal structures or in the pleuræ; (4) 317 suffering from carcinoma of the alimentary canal; (5) 82 who had carcinoma of the breast; (6) 56 with tumours originating in the male genito-urinary tract; (7) 99 having tumours of the female genito-urinary tract; (8) 23 with abdominal carcinoma of uncertain primary origin, and 14 cases of miscellaneous tumours.

An examination of the cases included in these different sections showed the importance of the three factors mentioned above relative to the anatomical site of the primary growth. Detailed reference to these cases would be too lengthy for this contribution, but before presenting the conclusions which

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* These 'Notes' are part of an abstract from a thesis submitted for the degree of Master of Surgery of the University of London in 1928.

are based on an examination of the evidence provided by them, it is advisable briefly to outline the prominent characteristics noted in the different sections.

Section 1.—The cases included in the section comprising patients who had the primary *tumour above the level of the larynx* demonstrated the importance of the infective and mechanical factors in the symptomatology and progress of malignant disease. Dissemination of the tumour cell had not occurred beyond the cervical lymphatic system, and there was strong evidence pointing to a causal relationship between infective changes in the glands and invasion of the periglandular tissues. Relatively clean ulcers were accompanied by discrete glandular masses, foul ulcers were accompanied by fungating masses in the neck. The constitutional changes present in many of these patients were considered to be due entirely to a combination of the mechanical changes which interefered with deglutition, etc., and infection of the growth. Sepsis in the primary growth was responsible for serious lung lesions such as inhalation pneumonia, as well as for the usual complications which may arise from infected wounds.

Section 2.—The importance of the infective factor was very marked in *carcinoma of the larynx*; and the importance of sepsis relative to anatomical situation was clearly demonstrated—a small ulcer situated at the inlet of the lower respiratory tract being far more dangerous than a large fungating area situated, for example, on the chest wall. The mechanical changes resulting from the growth also aggravated the danger of pulmonary complications. Dissemination involved the local lymph drainage area, and infection of the primary growth appeared to have an influence on the extent of invasion of the surrounding tissues.

Section 3.—The serious changes which may result from the pressure effects of metastases were demonstrated by the cases of *bronchial carcinoma*. In these cases the tracheo-bronchial lymph-glands had been invaded, and their expansion due to the metastases produced lesions in the lung as a result of pressure on other structures in the hilum. Interference with the blood-flow in the pulmonary veins appeared to be of particular importance in the pathology, and gave rise to changes in the lung parenchyma well away from the primary growth. Congestive areas, pulmonary œdema, pleural exudate and adhesions, and even necrotic areas of lung tissue were apparently due to this mechanical factor; and these lung changes were the immediate cause of death. Examination of all the cases on which the present article is based suggests that these glands tend to be invaded in the later stages of all varieties of carcinoma, particularly in those cases in which the mechanical and infective factors are not dominant. Thus, for example, a clinical picture at first thought to be due to an unresolved pneumonia was found to be secondary to a carcinoma of the prostate, and in several other patients the lung changes were the first indication of a serious lesion in other parts of the body.

Section 4.—The cases of *carcinoma of the œsophagus* demonstrated the seriousness of mechanical obstruction. Many of those having the growth at the level of the fifth dorsal vertebra had metastases in the tracheo-bronchial glands, which led to the lung changes characteristic of the pressure effects due to enlargement of these glands.

The advanced cases of *carcinoma of the stomach* frequently had a wider dissemination of metastases than is usually recognized. Intrathoracic metastases were common, and probably resulted from the lymph paths opened up by invasion of the liver capsule.

The serious effects of mechanical obstruction of the intestine were seen in the cases of *carcinoma of the colon*; fatal infective complications were met with in patients who had a primary growth that might have ended in excellent results had earlier hospital assistance been sought. Distant metastases appeared to occur far less rapidly than in other types of tumours.

Carcinoma of the rectum showed the indiscriminate destructive action of the primary growth. Infiltration of the bladder led to urinary fistula and to ascending urinary tract infection. The perineum and abdominal wall tended to be invaded by a slow-spreading destructive ulcer which when infected led to fungating masses in the lymph-drainage areas. Dissemination in cases of long duration was widespread, and appeared to be confined within the boundaries of the lymphatic system except in such organs as the liver.

Section 5.—The dissemination of malignant cells was well demonstrated in the patients suffering from *carcinoma of the breast*, several in whom the infective factor was negligible having extremely widespread metastases. Pathological fracture of the femur occurred in one patient, who had acute carcinoma, within a few weeks of the onset, and the rapid occurrence of backache and evidence of spinal metastases suggested that the dorsal lymphatic system might be responsible for the quickness of the spread. Examination of the spine in several other cases supported this view. The rôle of infection in increasing the seriousness of the prognosis, and in apparently stimulating the growth of tumour cells, was noted in several of these patients.

Section 6.—Probably no other section was as interesting as this one in demonstrating the importance of the three factors mentioned above. The mechanical factor alone was responsible for symptoms and pathology in a few of the cases of *carcinoma of the prostate*. The infective factor when present was extremely serious, as ascending urinary-tract infection usually supervened sooner or later. Dissemination was widespread in several patients, and the clinical picture was sometimes dominated by distant secondary growths. Widespread skeletal invasion occurred in a few patients, and was accompanied by masses of new growth in the upper dorsal region of the thoracic cavity, and by invasion of the tracheo-bronchial glands. An attempt to find the route of this dissemination led to a conception of the rôle of the dorsal spinal lymph path which is discussed later.

Seven patients having *carcinoma of the bladder* had no spread beyond the bladder, but infection had led to fatal urinary sepsis, and emphasized the importance of the infective factor relative to anatomical situation.

Section 7.—A widespread dissemination similar to that in some of the prostatic cases was found in several of the patients having *carcinoma of the cervix*. Infection of the primary growth produced pitiful and repulsive clinical pictures; while the indiscriminate invasion of tissues by the primary growth led to vesicovaginal and rectovaginal fistulæ with secondary infections.

Section 8.—The cases resembled those included in the other sections.

CONCLUSIONS.

Examination of the evidence provided by the 700 cases on which this paper is founded leads to the following conclusions :—

1. The mechanical and infective conditions associated with the primary growth are responsible for the greater proportion of the symptoms and of the deaths occurring in these patients.

2. Apart from these mechanical and infective conditions the gravity of the case appears to have a definite relationship to the distance between the mediastinal lymphatic system, particularly the tracheo-bronchial lymph-glands, and the lymphatics of the primary growth.

3. In the absence of mechanical and infective complications, all varieties of carcinoma tend to give rise to widespread metastases, and the most important route for the spread of the carcinoma cell is the lymphatic system. This system, while providing a path for dissemination, tends to localize the tumour cells within its own boundaries.

4. Evidence was found proving the existence of a dorsal spinal lymphatic path which is responsible for much of the widespread dissemination found in advanced cases.

1. **Mechanical and Infective Conditions.**—The pathology and treatment of these conditions differ in only one respect from those which are common to the mechanical and infective processes occurring in other diseases. The mechanical changes occurring, for example, as a result of carcinoma of the colon closely resemble those occurring as a result of the fibrosis accompanying a diverticulitis. The humoral defence of the organism, consisting of the various antibodies, is the same in carcinomatous ulcers as in other infected breaches of body surface. The cellular changes which are present in carcinomatous ulcers differ, however, from those which occur in other chronic ulcers because of the presence of a destructive factor—namely, the carcinoma cell. The other cellular changes may give rise to a marked degree of fibrosis, but the combination of the malignant cell with the infection leads to a gradually extending non-healing area and appears to increase the disseminating properties of the malignant cells.

2. **The Relation of the Primary Growth to the Mediastinal Lymphatic System.**—Examination of these cases justifies the conclusion that involvement of the mediastinal glands tends to occur in all patients suffering from carcinoma. The main spread of the carcinoma cell being by the lymphatic system makes the direct anatomical relationship between the primary growth and the mediastinal lymphatics of less importance than the distance by the lymphatic vessels. The obstruction of lymph-flow as a result of metastases in the glands may lead to the opening up of new paths between the affected areas of the body and the mediastinal lymphatics ; and the development of intrathoracic metastases as a result of these new routes may produce perplexing clinical pictures. Involvement of the tracheo-bronchial lymphatic system has been shown to result in very serious changes in the lungs, and an exceedingly grave prognosis is justified in all patients who have recent respiratory symptoms. The metastases in the liver are serious, not only on account of the difficulties in treatment, but also because of the important linking-up

between the capsular lymphatics with the mediastinal vessels, and the relatively early involvement of the tracheo-bronchial glands which results from these communications.

3. The Rôle of the Lymphatic System in the Dissemination.—The data obtained from a study of the 700 cases were based chiefly on macroscopic findings, and therefore no conclusions as to the relative importance of lymphatic permeation or of lymphatic emboli would be justified.

A large number of autopsies showed an indiscriminate invasion of surrounding tissues taking place in all directions from the primary growth. The spread along the lymph-vessels appeared to take place chiefly in the direction of the normal lymph-flow; but in several cases there was evidence pointing to an alteration of lymph-flow as a result of obstructive changes in the lymph-glands. Dilated lymph-vessels were most frequently found in relation with the lumbar vessels leading from the aorta to the tissues of the back; and the degree of dilatation appeared to correspond to the extent of the metastatic involvement of the abdominal glands, especially those lying near the upper part of the abdomen. The dilatation in most cases appeared to be a simple compensatory process which provided new channels for the lymph-flow from the abdominal cavity, but in a few cases some of these dilated vessels were found to consist of permeated lymph cords. This formation of additional or alternative lymph routes may therefore offer new paths for the dissemination of carcinoma cells.

The tendency to restrict carcinoma cells within the boundaries of the lymphatic system was very obvious in many of the examinations of cases of abdominal carcinoma. Large hard abdominal lymph-glands, connected by a dense network of enlarged permeated lymph-vessels forming a covering around and compressing the main blood-vessels, were encountered frequently in these examinations, but macroscopic invasion of surrounding tissues was rarely seen. Even in advanced cases infiltration of surrounding structures from these lymphatic deposits appeared to occur only when infective changes or necrosis due to expansion within a gland had altered the structure of the lymph-gland. Internal indiscriminate invasion of tissues appeared to occur to any extent only in bone, liver, and lung tissue.

2. The Posterior or Dorsal Spinal Path.—The discovery of plaques of new growth on the deep surface of the spinal laminæ and ligamenta subflava which occurred in a patient having a primary growth in the prostate, led to the suggestion of an intraspinous path for dissemination of carcinoma. Later autopsies have modified this view and have pointed to the existence of a much larger lymphatic path in the back. This dorsal path may not be important in the normal lymph drainage of the body, but may become prominent in the event of blockage of the intra-abdominal lymph-vessels. (*Fig.* 423.)

This dorsal path is considered to consist of the lymph-vessels lying deep to the lumbodorsal fascia as well as the vessels of this fascia. The lymphatic vessels lying in the erector spinæ muscles, and the lymph spaces present between the elastic and fibrous tissues which make up the connecting ligaments of the spinal laminæ, form an important part of this dorsal lymphatic system. Sections across the laminæ suggest the presence of lymph channels

lying in relation to their intraspinal surfaces; and one case in particular showed the presence of what appeared to be large lymph-vessels full of carcinoma cells in this situation.

The suggestion advanced as a result of the study of many post-mortem examinations is that this dorsal spinal system is responsible for many of the

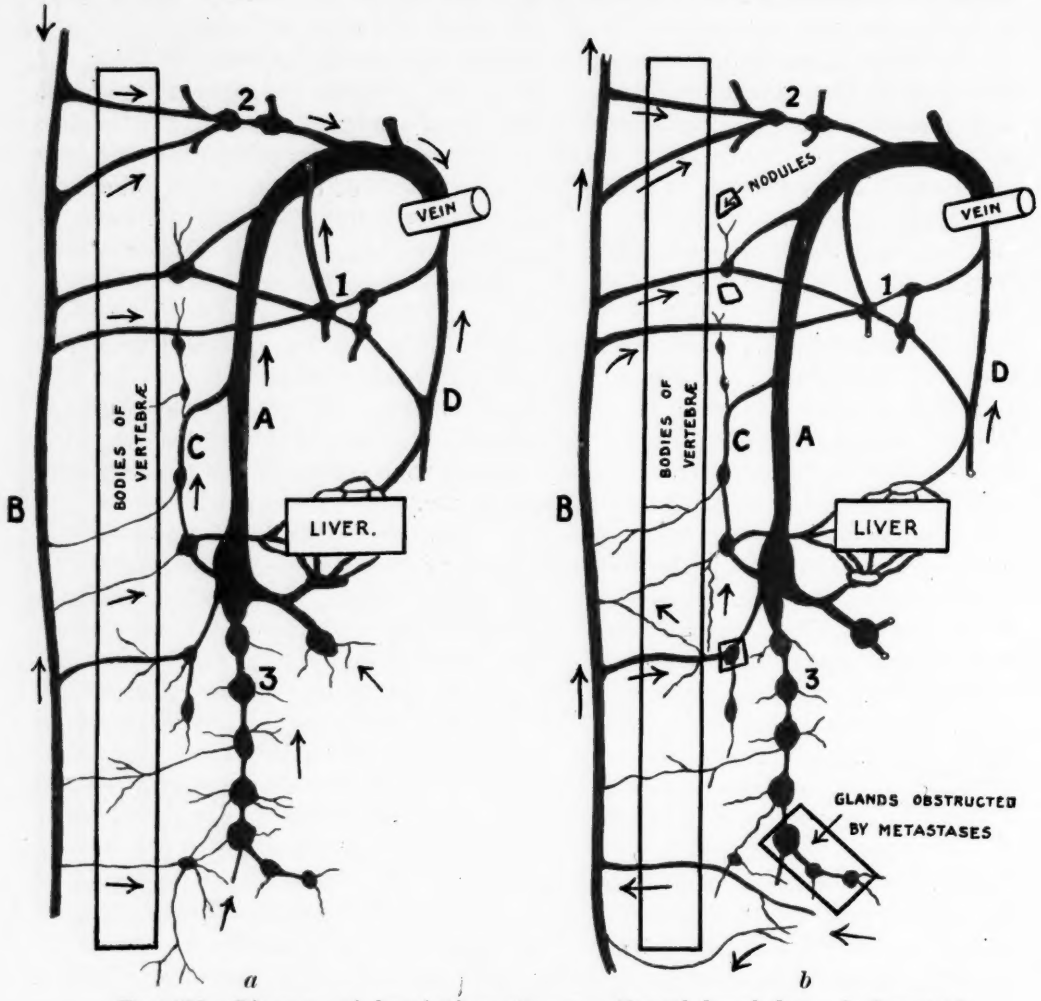

FIG. 423.—Diagrams of lymphatic systems. *a*, Normal lymph-flow. *b*, Suggested flow in carcinoma of the prostate with obstruction of the lower abdominal glands. Obstruction of any gland may lead to reversal of lymph-flow and the opening up of new paths for dissemination of carcinoma cells. 1, Tracheo-bronchial glands; 2, Supra-clavicular glands; 3, Abdominal glands. A, Chief anterior lymph system; B, Dorsal spinal system; C, Posterior mediastinal lymphatics; D, Anterior mediastinal lymphatics.

widespread metastases found in all varieties of carcinoma. This dorsal lymphatic system links up the sacral with the cervical regions, and it is suggested that vessels acting as anastomosing channels linking up the intra-thoracic and intra-abdominal systems with the dorsal system pass to the back in relation with the dorsal branches of the lateral arteries from the aorta. There is strong evidence in favour of the presence of large communicating

vessels at two levels: (1) At the upper dorsal region, particularly near the fourth dorsal vertebra; and (2) At the level of the second lumbar region near the right renal vessels. The frequency with which masses of new growth have been found near bodies of the upper dorsal vertebræ, and the frequency with which the glands lying near the right renal vessels have been found enlarged in different varieties of carcinoma, suggest an anatomical cause for these metastases.

Communication between the main lymphatic vessels and the dorsal system may occur at any level—for example, if the lower para-aortic glands became obstructed as a result of invasion by carcinoma cells from the prostate, channels may dilate in the pelvis and pass through the anterior sacral foramina and thus lead to permeation of the vessels in relation with the laminæ, and ultimately reach the upper dorsal region, giving rise to intrathoracic metastases. Metastases, or operation, causing obstruction of the axillary glands, may lead to involvement of this dorsal path from a breast tumour, and metastases may develop in the pelvis or lumbar vertebræ, etc.

A suggestive anatomical consideration in relation with this dorsal path is the fact that the supraclavicular glands normally drain the lymphatics of the back.

SUMMARY OF THE CONCLUSIONS.

The importance of mechanical and infective conditions associated with the malignant tumours is emphasized.

The lymphatic system not only offers a path for dissemination of the tumour cells, but also tends to localize the malignant cells within its own boundaries.

There is a dorsal lymphatic system which plays a very important part in the spread of carcinoma cells and which may be responsible for widespread dissemination.

APPENDIX.

The Anatomy of the Tracheo-bronchial Lymph-glands.

(*After Poirier.*)

These glands are subdivided into four groups:—

1. *The Right Para-tracheo-bronchial Glands.*—These glands are situated in the angle between the trachea and the right bronchus. Anteriorly they are in relation to the superior vena cava; internally is the trachea; externally the right lung; and inferiorly the right bronchus, the right pulmonary artery, and the vena azygos major.

2. *The Left Para-tracheo-bronchial Glands.*—These lie close to the trachea and left bronchus and have the following relations: anteriorly, the ascending aorta; internally, the trachea; externally, the left lung; inferiorly, the left bronchus and the left pulmonary artery.

3. *The Intertracheo-bronchial Glands.*—These are placed in the angle of bifurcation of the trachea. Their relations are: superiorly, the trachea; anteriorly, the pericardium (one of these glands according to Baréty has a

lymph channel opening directly into the left auricle); posteriorly, the œsophagus.

4. *The Interbronchial Glands.*—These are buried in the hilum of the lung and lie in the angles of division of the larger bronchi. These glands are in *intimate* relation with the branches of the pulmonary vessels.

The interbronchial glands receive afferents from the superficial as well as the deep collecting trunks from the lung and visceral pleura. The inter-tracheo-bronchial glands receive afferents from the neighbouring structures, and particularly—from the point of view of malignant disease—from the œsophagus. The lymphatics from the œsophagus are in communication with the posterior mediastinal glands, which receive afferent branches draining the posterior intercostal glands and intercostal spaces. These œsophageal vessels also receive branches from the middle group of diaphragmatic glands which drain the middle portion of the diaphragm and therefore communicate with the lymph-vessels of the capsule of the liver.

The right and left para-tracheo-bronchial glands have communications with the lymph-vessels which accompany the internal mammary vessels, the phrenic nerve, and also the great vessels in the superior mediastinum.

The communications existing between the abdominal lymphatic system and the vessels of the anterior and posterior mediastinum offer a path by which the tracheo-bronchial glands may become invaded from carcinoma occurring in the abdomen.

It is interesting to note that the internal mammary lymph-trunks may open directly into the subclavian veins, and thus may provide a new channel for lymph from the thorax, abdomen, and lower limbs in the event of gradual occlusion of the normal channels.

SHORT NOTES OF RARE OR OBSCURE CASES

CASE OF DOUBLE TONGUE.

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Whilst cases of bifid and tri-lobed tongues have been frequently quoted in the literature, only three cases of double tongue can be found, so that a further example of this congenital anomaly, which is not so easy to explain on embryological grounds, seems worthy of record.

History.—J. B., a female, was first seen when one month old. The history was that birth was normal, but the nurse had noted that the child apparently had two tongues, which caused considerable difficulty in suckling. The child's mother had a congenital dislocation of the hip, but there was no abnormality of mouth or tongue in either parent. The child was brought to the Bristol General Hospital by its mother because it had frequent choking attacks.

Fig. 424.—Double tongue. The lower figure shows the accessory organ drawn to half scale.

On Examination.—The patient was found to be rather a puny baby, weighing 7½ lb. A careful examination of the mouth failed to reveal any abnormality. The region of the nasopharynx was explored with the finger, but nothing abnormal was detected. The history given by the mother of attacks of difficulty with respiration and of a swelling appearing from time to time in the mouth was so clear and definite that it was thought advisable to admit the child for observation.

Shortly after admission the child had a fit of coughing. When its mouth was opened a most extraordinary condition was found, for lying on top of the tongue was a second smaller one (*Fig.* 424). This was at once seized

with a pair of forceps and pulled forwards. It was found to be attached by a pedicle to the extreme base of the tongue. The pedicle was immediately transfixed and the accessory tongue removed. It is clear that at the time of the first examination this accessory tongue had fallen back into the larynx and was missed by the examining finger.

On examination its appearance was found to resemble exactly a tongue, with a well-marked median raphé. On section it was seen to be covered with squamous epithelium, possessing a core of connective and muscular tissue. The muscular tissue was striped and was found to run in two planes. Its structure was quite simple and closely resembled that of a fœtal tongue. The general appearance and microscopic structure indicated that it was a congenital anomaly rather than any form of benign new growth.

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ANEURYSM OF THE SPLENIC ARTERY.

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ONE night in April, 1929, a woman of 69 retired to bed feeling perfectly well and contented after a dinner composed largely of lobster. She was awakened about 4 a.m. with violent pain which was felt mainly in the left upper quadrant of the abdomen. She vomited and felt an intense desire to defæcate. Thinking that the lobster was to blame she took a vegetable laxative pill, but no action of the bowels could be obtained even after four attempts, although the desire was still present. The pain continued and the vomiting became incessant. I was asked to see her about 9 a.m., when she looked in danger of imminent death. The temperature was 97°, and a pulse of 120 was hardly perceptible at the wrist. The shock, the character of the pain, the inability to pass either fæces or flatus, and the persistent and progressive nature of the vomiting pointed to a diagnosis of acute intestinal obstruction.

On following my invariable practice of examining all acute abdominal cases with a stethoscope, I heard in the left hypochondrium, and only there, a sound which could have been nothing else than the bruit of an aneurysm. A careful examination showed that the thoracic aorta was free from blame. On leaving the patient's room I asked the practitioner to listen to the upper abdomen, being careful to give him no hint of what I wished him to hear, When he rejoined me he asked, "What can it be?" I replied that it must be an aneurysm of the splenic artery which had ruptured.

Operation was decided upon and ¼ gr. of morphia was administered hypodermically. Within a few minutes the patient was free from pain and was pink and warm; the vomiting ceased at once, and the pulse was 90 and of good volume. This reaction to the drug seemed so like that of a case of acute obstruction that I wavered in sticking to what appeared such an outrageous diagnosis. I ordered an enema, and since there was no result I finally

made the diagnosis of acute intestinal obstruction due to a vascular growth of the splenic flexure in which I had heard a souffle.

When the patient was placed on the operating table, the anæsthetist, who had been told the physical signs, was asked to listen. After a careful examination he turned round and with an indulgent smile told us that there was nothing to hear. The doctor and I both listened again and the bruit had completely disappeared.

The abdomen was opened through a split rectus incision extending downwards from the tip of the ninth left costal cartilage. There was no free fluid in the general peritoneal cavity. There was no growth anywhere, but the whole of the intestine, both large and small, was in a state of marked spastic contracture. On gently exploring the region of the spleen about a pint of blood-clot escaped from the splenic pedicle. Splenectomy was performed and all bleeding was thereby controlled. The abdomen was then closed. The spleen when seen within the abdomen was very small and showed a dark blue colour beneath a pale white anæmic capsule. No aneurysm sac was seen, since the tissues of the splenic pedicle were so ploughed up by the hæmorrhage that any differentiation of the vessels in that situation was impossible.

After a very stormy convalescence due to an extensive massive post-operative collapse of the lung on the left side, the patient recovered and is now—ten months later—in as good health as before the illness.

Before commenting on this case it seems worth while to recount the history of a case seen in 1913 of which I have still some rough notes, for it was a recollection of this instance which influenced my line of thought in the present case.

"A man was admitted to a medical ward for a sudden attack of acute abdominal pain. The diagnosis was obscure and he was treated on expectant lines with rest and morphia. About two weeks later he was suddenly seized with violent abdominal pain, vomited, passed blood by the bowel, and died in an hour. The post-mortem revealed an aneurysm of the splenic artery which had ruptured secondarily into the large intestine."

These two cases, with the one reported by Anderson and Gray[1], indicate a fairly definite course which may be expected in cases of aneurysm of the splenic artery and give some measure of hope of success in treatment. A primary rupture takes place into the lesser sac or the splenic pedicle. This is not usually fatal, since clotting occurs in a short time, as is evidenced by the loss of the bruit which was noticed in the case here reported. Later, after an interval of two or three weeks, the secondary rupture takes place, with a rapidly fatal termination.

This case illustrates only one instance of the very great value of abdominal auscultation in acute conditions. If I had not heard the bruit, my patient would probably have been opened by a median sub-umbilical incision. Nothing would have been found, and she would have been closed, to await death from a secondary rupture some days later.

REFERENCE.

[1] Anderson, W., and Gray, J., *Brit. Jour. Surg.*, 1929, xvii, 267.

MIDDLE CEREBRAL EMBOLISM FOLLOWING PARTIAL THYROIDECTOMY FOR GRAVES' DISEASE.*

By LAMBERT ROGERS,

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WHILE post-operative embolism not infrequently occurs in the pulmonary circulation and becomes manifest either as an infarction of the lung or, if more massive, as an obstruction to one of the main branches of the pulmonary artery, it is less frequently met with in the systemic circulation. The following, however, is an example subsequent to partial thyroidectomy performed for exophthalmic goitre with auricular fibrillation. The embolism, which occurred on the eleventh day after operation, coincided with the return of auricular systole, and apparently occluded the stem of the left middle cerebral artery. The patient eventually made a good recovery both from the exophthalmic goitre and the distressing complication.

HISTORY.—A charwoman, age 54, was referred by Dr. Ivor Davies to the Medical Unit and subsequently transferred to the Surgical Unit for operation. She was a typical case of old-standing true exophthalmic goitre with auricular fibrillation, and prior to operation was treated with Lugol's iodine solution.

OPERATION.—On Sept. 19, 1929, under novocain analgesia, bilateral partial thyroidectomy was performed, leaving only a strip of thyroid tissue in front of the hilus of each lateral lobe. At the time of operation the pulse-rate was about 108, and afterwards there was a slight acceleration to 136. The pulse remained irregularly irregular. For a week before operation and for five days afterwards she was given Nativelle's digitalin granules.

SUBSEQUENT HISTORY.—On the eleventh day after operation, when the pulse-rate had fallen to 62 and become regular, she suddenly developed right hemiplegia, incontinence of urine and fæces, and aphasia. The hemiplegia was at first flaccid in type, but later became very slightly spastic. A sound something like a muttered 'no' was the only expression to which she occasionally gave voice. At times she appeared able to recognize objects and their use and to be attempting to talk, but was quite unable to, while at other times she could not mutter, and appeared oblivious of her surroundings. A diagnosis of embolism in the main trunk of the left middle cerebral artery was made, the non-spastic hemiplegia with aphasia suggesting a cortical rather than a capsular lesion.

Three days after the onset of the hemiplegia there was slight return of movement in the right arm and leg, but she was still unable to speak. Three days later, however, the arm movements were more complete and the leg could be flexed at the hip and knee. Both plantar reflexes were flexor in

* From the Surgical Unit of the Welsh National School of Medicine, Royal Infirmary, Cardiff. This case was shown at a meeting of the South Wales and Monmouthshire Branch of the British Medical Association, held at Cardiff on Nov. 21, 1929.

type. There was slight weakness of the right side of the face. Three weeks later, at the time of her discharge from hospital, she was able to walk and use her arm, and she could speak, although imperfectly.

Commentary.—Although it seems reasonable to expect a tendency to embolism by the dislodgement of thrombi formed in fibrillating auricles when the resumption of normal auricular systole takes place, and emboli following the restoration of a regular rhythm in cases of auricular fibrillation treated only by quinidine and other drugs have been recorded by Wilson and Hermann,[1] Frey,[2] Benjamin and von Kapff,[3] Ellis and Clarke Kennedy,[4] and others, cerebral embolism is apparently a very rare complication of operation for Graves' disease.*

In the case here reported the relief of the condition by operation, and not the operation itself, must be looked upon as the cause of the embolism, the production of a slower and regular cardiac rhythm resulting in the liberation of the thrombus.

The site of the obstruction was presumably the left middle cerebral artery at its division in the Sylvian fissure into its infero-external frontal branch to Broca's convolution, and its ascending frontal branch to the precentral gyrus, and the cutting off of the blood-supply to these areas resulted in aphasia and hemiplegia. As the middle cerebral artery enters the Sylvian fissure it is much the largest of the terminal branches of the internal carotid, and appears to be the continuation of the parent trunk, so that emboli in the internal carotid tend to pass into and along the middle cerebral until obstructed at its division. It is well known that emboli leaving the heart by the aorta more frequently pass to the left middle cerebral artery because of the more direct course of the blood-stream in the left common carotid artery than in the innominate and right carotid systems, which are slightly directed away from the line of the blood-stream in the aorta.

The patient's recovery is now almost complete, the pulse is 72 and regular, tremors have disappeared, and there has been improvement in the exophthalmos, which is now much less apparent. She can walk and use her arm quite well, and although speech is not yet very fluent, it is daily improving.

REFERENCES.

[1] Wilson, F. N., and Hermann, G. R., "Cerebral Embolism following the Arrest of Auricular Fibrillation by Quinidin", *Jour. Amer. Med. Assoc.*, 1922, lxxviii, 865.
[2] Frey, *Zeits. f. d. ges. exper. Med.*, 1921, xxv, 290.
[3] Benjamin and von Kapff, *Deut. med. Woch.*, 1921, xlvii, 10.
[4] Ellis, A. W. M., and Clarke Kennedy, A. E., *Lancet*, 1921, ii, 894.

* Some idea of the rarity can be gathered from the fact that Sir James Berry from his extensive experience writes in a personal communication, "I have never met with any case of cerebral embolism as a post-operative complication of any thyroid operation", and although from his experience of over two thousand thyroid operations Mr. T. P. Dunhill tells me of three cases, of these two had had several attacks, one of them having suffered from emboli both before and after operation. The other case occurred fifteen days after operation and was fatal twenty-two days later.

PERSISTENT HÆMATURIA FROM A MINUTE PAPILLOMA OF THE RENAL PELVIS.

By JAMES C. ANDERSON,
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THE following case would almost certainly have been classed as one of 'essential hæmaturia' if the bleeding had not been so copious and persistent as to necessitate operation. It is more than probable that, had a nephrectomy not been performed, this minute growth would have been overlooked, even though the kidney had been split in two. The same may be said of any very small lesion of the renal pelvis, such as small nævi or very early tubercle. In this particular instance, no apology is offered for such drastic procedure as removal of the kidney, since, as far as we know, such papillomata of the kidney pelvis eventually become malignant.

The patient, a robust, healthy adult, age 33 years, a clerk by occupation, was sent to me by Dr. A. M. Duthie, D.S.O., M.C., from New Whittington.

HISTORY.—On the morning of Feb. 23, 1929, he performed vigorous physical exercises; an hour later he was alarmed to see that his urine was deeply blood-stained. This symptomless hæmaturia persisted, but gradually became less in amount during the ensuing week, at the end of which his urine was but 'slightly turgid'. On March 1, after dancing, the copious hæmaturia reappeared. It tailed off until, on the morning of March 3, his urine appeared to be absolutely clear, but a long walk on this day caused the hæmaturia to reappear before night; this is the only occasion, prior to removal of the patient's left kidney, on which his urine was known to be free from visible blood.

ON EXAMINATION.—I saw him on March 7. His urine was like port wine in colour and there were no other symptoms or physical signs. The urine contained red-blood corpuscles, but presented no other physical or chemical abnormality. Radiological examination disclosed a chain of shadows on the left side of the pelvis, but subsequent pyelography showed that they were not in the line of the ureter. Cystoscopic examination showed rhythmic jets of blood issuing from the left ureteric orifice. Intravenous indigo-carmine appeared from the right ureter in three and a half minutes, and at the same moment the blood from the left side became darker in colour. The kidneys were excreting the dye equally and normally. Pyelography showed a normal left renal pelvis. The patient's blood-pressure and blood non-protein nitrogen were low.

After absolute rest in bed for three weeks the hæmaturia persisted and cystoscopic findings were unchanged. Another two weeks in bed, followed by a further cystoscopic examination, confirmed the previous findings. The hæmaturia persisted.

OPERATION.—Having made a diagnosis of a villous papilloma of the renal pelvis, I decided to expose the patient's left kidney, and on April 30,

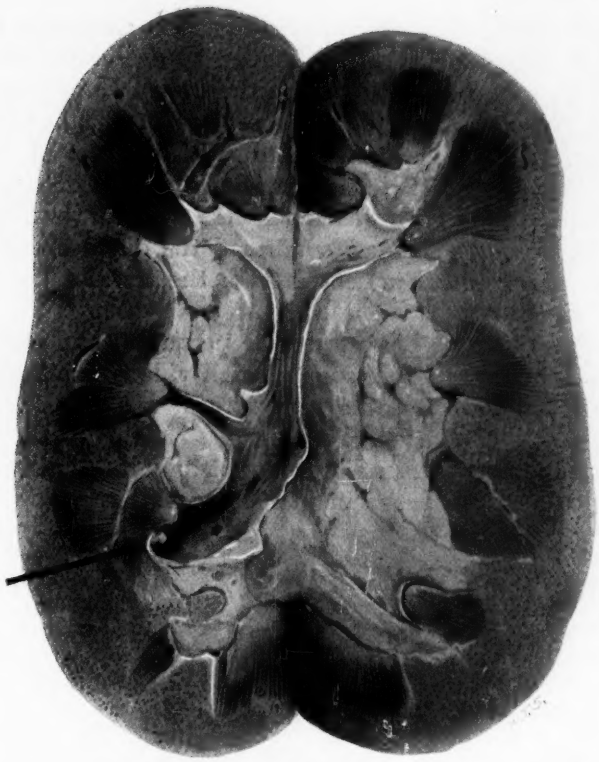

FIG. 425.—Kidney removed at operation. The arrow indicates a small villous papilloma responsible for ten weeks of persistent visible hæmaturia, one morning excepted.

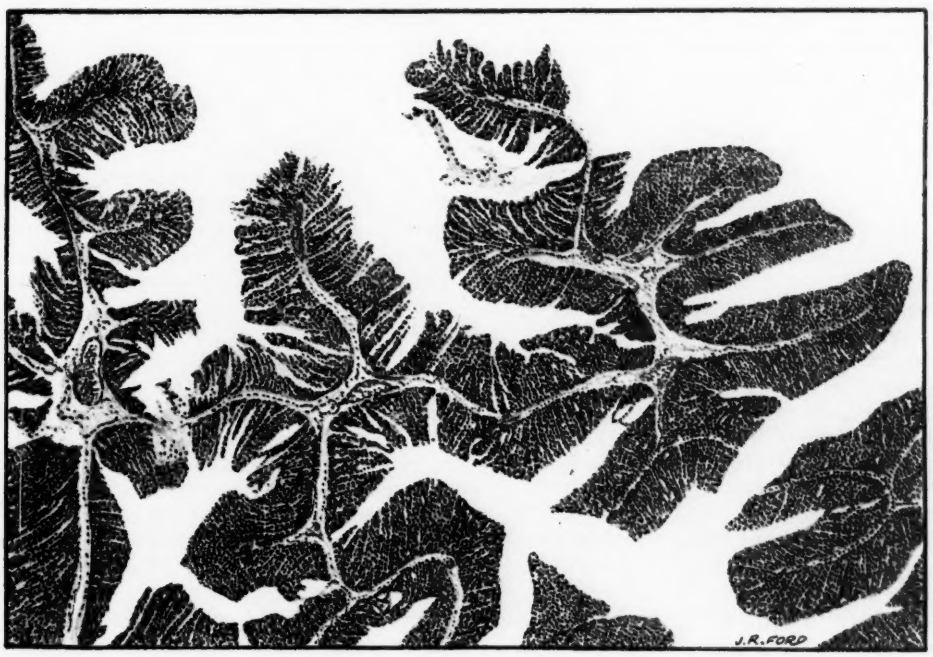

FIG. 426.—The microscopic appearance of the papilloma indicated by the arrow in *Fig.* 425.

after ten weeks of visible hæmaturia, one morning excepted, I removed an apparently normal kidney (*Fig.* 425). I failed to detect the small papilloma seen close to the apex of a renal papilla in the lowest calix (marked by arrow in diagram) and had sections made from several of the hæmorrhagic areas, thinking that these might be hæmangiomatous. They proved to be traumatic in origin. Fortunately, I showed the specimen to Mr. Graham Simpson and he located the papilloma, which was much less evident than the illustration might suggest. Microscopic sections confirmed the diagnosis of villous papilloma (*Fig.* 426). The hæmaturia ceased from the time of the operation and has not recurred since.

I have recorded this case because of the persistent and copious character of the hæmorrhage that came from such a small villous papilloma of the renal pelvis and because I believe it to be very rare, if not unique.

I am indebted to Mr. Graham Simpson, not only for finding the papilloma, but also for advice and assistance in publishing this case.

REVIEWS AND NOTICES OF BOOKS.

Gastric and Duodenal Ulcer. By ARTHUR F. HURST, M.A., M.D. (Oxon.), F.R.C.P., Senior Physician, Guy's Hospital; and MATTHEW J. STEWART, M.B. (Glasgow), F.R.C.P., Professor of Pathology, University of Leeds; with the co-operation in the Radiological Sections of P. J. BRIGGS, M.A. (Cantab.), M.R.C.S., L.R.C.P., Radiologist to New Lodge Clinic and the Medico-Neurological Clinic, Guy's Hospital. Crown 4to. Pp. 544 + xvii, with 159 illustrations and 10 coloured plates. 1929. London: Humphrey Milford. 63s. net.

THIS book in respect of many of its parts is the best presentation in our language of a vast and difficult subject. It reflects great credit upon the industry and the learning of its authors; and not less upon its publishers, for type and illustrations are very good. The new knowledge of this subject that has developed during the last quarter of a century is very largely the outcome of the labour of surgeons in this country and in America. Hypothesis and guess-work are being gradually displaced by real knowledge derived from inspection of parts by the surgeon, and by the correlation of discoveries made during operation with the history of the patient and with all laboratory findings. It is amusing now to recall the distrust amounting to frank disbelief with which physicians greeted the pioneer work of surgeons; and it is worth while to remind ourselves of the debt owing to surgeons not only for their discoveries, but for their stern defence of what is now known to have been an impregnable position.

The historical section in this volume is admirable; a full and most interesting survey of the whole progress of our knowledge is made. The work of Cruveilhier, regarded by many as the earliest of any value on this subject, is placed in true perspective, and its relation to the earlier work of Matthew Baillie, Abercrombie, and others, and to the almost contemporary work of that great physician and master of English prose, Brinton, is at last made plain. We have learnt much since in 1856 Cruveilhier laid down the dogma that a gastric ulcer could with safety be diagnosed in the presence of such clinical conditions as pain, vomiting, and hæmatemesis. Hurst's work, consolidating rather than creating opinion, dealing with the diatheses which make probable the development of a gastric or duodenal ulcer, is being corroborated by other observers; and though it does not express the whole truth it affords a clue to a multitude of interesting problems. No one has more rightly or more successfully indicated the necessity for a full inquiry into all aspects of peptic ulceration than Hurst. The exact value of clinical inquiry, pathological investigation, radiological methods, and their value in association with one another are all admirably, lucidly, authoritatively discussed; and the truth of the matter is freed from its ancient obscurities. The pathology of gastric ulcer is discussed by Stewart, who has done more than any other man to base our knowledge upon accurate investigation. His observations, made with great caution, as to the incidence of carcinoma upon ulcer, for example, are not always or generally accepted, but his position appears here as elsewhere to be so soundly based as to be irrefutable. It is not through lack of warm appreciation, but because of a desire to see the minor defects of a great work removed in future editions, that we propose to offer criticism.

Great hindrance to knowledge has been created in the past by too ready acceptance of post-mortem statistics. The authors do not yet perhaps realize that the material which reaches the post-mortem room is not to be regarded as affording

an average sample of the rest of the community; and that as was said long ago, "people do not often die in hospital from the chronic diseases from which they suffer during life". For example, it is here stated that because in 95·5 per cent of post-mortems a chronic ulcer of the stomach or duodenum is found, "it may therefore be assumed that about 10 per cent of all individuals suffer at some time in their lives from a chronic or duodenal ulcer". May we therefore assume that since a pregnant woman is rarely found on the post-mortem table, there are few births?

A similar fallacy of drawing general conclusions from inadequate individual data occurs on page 291, where Nielsen's statistics are quoted. The total incidence of perforation of ulcers is asserted to be infrequent because among 182 patients of Faber's in whom an ulcer was diagnosed with a 'fair degree of certainty' between 1897 and 1915, 42 had undergone operation, but none for perforation. How many diagnoses of either gastric or duodenal ulcer made by any physician on the Continent of Europe between 1897 and 1915 were to be accepted with a 'fair degree of certainty'? No one familiar with the literature or with medical or surgical clinical work on the Continent, which lagged far behind our own in vision and in accuracy, will find any difficulty in answering that question.

Again, on page 101 it is stated that in the post-mortem room duodenal ulcers and scars are equally common on the anterior and posterior walls, and that in Leeds nearly half the cases seen post mortem showed a lesion in both situations. No surgeon will agree that this is at all comparable to the conditions found during life.

The division of ulcers into acute, subacute, and chronic is needlessly complex. The term subacute in connection with ulceration was first used in connection with perforation. Here it was necessary, for there is a wide difference between the clinical symptoms and signs of the three degrees of perforation. A subacute ulcer is, however, nothing more than a brief stage between an acute and a chronic ulcer. The authors indeed say that it represents only a transition stage, probably short, and that ulcers in this stage are not often met with in the operating theatre or in the post-mortem room. It is clear that confusion exists in the minds of the authors, for it is stated in relation to the duodenum that there is "little doubt that many of the anterior-wall ulcers which perforate are in this transition stage." Nothing is more certain than that the great majority of duodenal ulcers which perforate have given rise to symptoms for months or years, and are, beyond any question, in the chronic stage, in spite of Nielsen's statistics which affirm that perforation is the first symptom in 10 per cent of cases. Many of Nielsen's cases, we feel sure, were not cases of ulcer, but of those various conditions which closely mimic the symptoms of ulceration, and with which Continental physicians are not closely acquainted. This is an example, of which there are many in the book, of expressions of opinion upon matters outside the province of the writers. A pathologist sees only the fatal cases of perforation and should not pass opinion on any but that small proportion: he cannot know what relation, so far as numbers are concerned, they bear to cases of ulcer.

The account of the symptoms of perforation of ulcers is not, we feel sure, written by an eye-witness. English literature already contains a description of perfect, even dramatic, accuracy of which the authors might with advantage have taken note. And certain of the old errors are repeated. In reviews of the excellent books of Mr. Zachary Cope we have protested against the inaccurate use of the word 'shock' as descriptive of the condition present in the early stages after perforation. We are told here that the pulse immediately after perforation is small, weak, and rapid. It most certainly is not. It is further stated that in the stage of reaction which comes on "in a few minutes or at most after two or three hours" the area of liver dullness diminishes owing to the escape of gas through the perforation. When will physicians realize that signs of peritonitis are not signs of perforation, and that when liver dullness is diminished the diagnosis of a catastrophe is too obvious for anyone to mistake it? When will authors write of their own knowledge and observation and cease to copy once again the ancient errors?

In discussing the differential diagnosis between a case of perforated ulcer and a case of acute pancreatitis, it is stated on page 297 that the tendency to obesity

in patients with the latter condition often helps the diagnosis. The tendency may be there, but it is hardly constant enough to be of value in diagnosis. In connection with subdiaphragmatic abscess, perforation of a gastric or duodenal ulcer is given as the commonest cause. We venture to think that appendicitis is a much more frequent cause.

The vexed question of the incidence of malignant degeneration in a gastric ulcer is considered very carefully, and the microscopic differentiation of ulcer-cancer and cancer-ulcer is discussed in great detail. Doubtful cases are rejected, and even then we arrive at 6·1 per cent incidence of carcinoma from ulcers or that in 15·7 per cent of cases of carcinoma the evidence points to their origin in ulcers. These figures are in marked contrast to MacCarthy's figures of 71 per cent and 68 per cent respectively, and although they are probably on the low side, as all doubtful cases have been rejected, they approximate more nearly to the truth. Even with this small number we have to ask ourselves whether medical treatment can ever justify itself. We all know how difficult it is to cure permanently a case of carcinoma of the stomach by operation, and medical treatment may be tried and valuable time lost during which the growth exceeds the bounds of operability. Purely medical treatment for chronic ulcer will apparently have a minimum mortality of 6·1 per cent, whereas purely surgical treatment in the hands of an expert has a mortality of about 3 per cent. A judicious combination of the two methods should give a slightly lower general mortality. The choosing of cases is one of the most difficult of tasks, and the most reliable guide which is given to us is that cases which do not quickly respond to medical treatment should forthwith be treated by operation. There is a further mortality also to be added from perforation or hæmorrhage occurring in cases during treatment.

One other criticism must be formally and earnestly made. A chapter is devoted to surgical treatment, and it is headed by a quotation from Bastedo, " The internist can refer his failures to the surgeon in good condition for operation, but in what condition does the surgical failure come to the internist ? " Is it possible for prejudice to go further ? Are the failures of the internist in good condition ? Are the cases of perforation, of hæmorrhage, and of obstruction—all or almost all of them failures of medical treatment—in good condition ? Are the cases of cancer following ulcer—the most inescapable of all disasters—favourable for operation ? The answer is evident. We regret that the authors should perpetuate so foolish a statement, and place it in a position of honour at the head of a chapter. Our objection to this chapter is based not only on surgical but on philosophical grounds. No physician is competent to appraise the exact indications for any particular operation. When medical treatment has failed he must acknowledge it and leave the question as to whether an operation is necessary, as to which operation best meets the indications as he sees them, and as to the time of operation, to the only competent authority, the surgeon. This chapter is *ultra vires*. It bears only too plainly the evidence, throughout, of imperfect or pitifully inaccurate knowledge or apprehension of the points presenting themselves to the surgical mind.

The 'choice of operation' discussed here is not worthy of the writers and should be omitted in any future editions. There are no competent surgeons who would accept the arguments or agree with the conclusions here expressed. We are told that the pyloric vein is not a reliable guide to the pylorus, when as a matter of fact it is so consistently situated at the junction of the stomach and duodenum as to make a certain distinction of the two easily possible on inspection alone. The operation of gastroduodenostomy is severely criticized, and it is stated that both on clinical and theoretical grounds it should be abandoned. Theoretically it may be said not to carry the acid gastric contents away from the duodenum, but in practice it appears to give the most satisfactory results. It appears to be far less likely to be followed by anastomotic ulceration than a gastrojejunostomy, and for this reason alone is well worth a more extended trial than it has so far received. There are cases when it should not be performed, notably those in which there is some degree of chronic obstruction by the superior mesenteric vessels ; it may be that its performance in cases of this type is the cause of the clinical condemnation which is made. A criticism of this kind is recognized by those who know the

surgical side of the problem as a reflection not upon the operation but upon the knowledge and experience of the authors. *Ne sutor ultra crepidam.* Cholecystgastrostomy for ulcer is condemned, and it is stated that there is a considerable risk of cholecystitis developing, and that stomach contents do sometimes enter the gall-bladder. The former is a statement which is not supported by any confirmatory evidence, and as to the latter we know that if this does occur no harm results.

Gastrojejunal ulcer is dealt with in a very full and exhaustive chapter. It is stated that it may arise many years after the performance of gastro-enterostomy, and although this is undoubtedly true, its incidence after the first eighteen months is decidedly uncommon. Many series of figures are quoted as to the proportion of cases in which it occurs, and a post-mortem series is here given which shows anastomotic scarring or ulceration in 73 per cent of cases. The extent of this scarring is not indicated, and it is probable that the result of healing at the time of operation has been mistaken for the scarring of chronic ulceration. The authors admit that it is an excessive figure, but suggest that the true figure should be considerably in excess of the 1 to 2 per cent put forward by surgeons. The latest clinical figures by Luff show an incidence of 2·8 per cent. When we see the wide variation in these figures we are reminded of the adage that statistics can prove anything, even the truth. No doubt much depends upon the skill of the operator, and this is a factor difficult to express in statistical form.

We venture to think that the most important chapter in this book is concerned with medical treatment. Surgeons have long regarded their work as only complementary to that of the physician. Were the physician's work adequately carried out by a loyal patient, fewer cases would come to operation. The medical treatment of patients, having regard to the whole country, is far too trivial and perfunctory, and has been shown by Moynihan—"a physician doomed to practise surgery"—to have far greater dangers than surgical treatment. The authors rightly urge a closer attention to the details of diet and drugs, and to a longer observance of necessary routine. We incline to think that even they underestimate the time necessary to accomplish healing. McLean, whose name does not appear in the chapter concerned with treatment, published details of cases in which X-ray pictures were supposed to show the healing of ulcers of moderate size in approximately three weeks. This statement was received with doubt and incredulity; for it was realized that an ulcer of the size depicted, if placed under most favourable conditions on the surface of the body, would never heal so rapidly; and we were reluctant to believe that in respect of rate of healing a gastric ulcer had advantages over all others. We think the stern ritual of Hurst is a far more effective method for the healing of ulcers than any yet advanced. The rather perfunctory method associated—quite inaccurately, as all acquainted with the literature know—with the name of McLean, who contributed nothing novel but his name, has in practice proved, in our judgement, very ineffective.

It may be that we are approaching the prophylactic period where we may warn people with the ulcer diathesis of the dangers they run, and put before them Bastedo's dictum—"a peptic ulcer will not develop in any individual who takes pains to secure a sufficient number of hours of sleep, to take plenty of time for his meals, to avoid indigestible food, to avoid the immoderate use of tobacco, and to make sure he is not harbouring any foci of infection"! An ulcer, that is to say, will not develop if an individual lives a life different from that of most ordinary people!

The volume is well written in spite of one or two lapses, as in the text under Plate 11, where a patient is referred to as having perforated, when obviously it is the ulcer which is meant, and the title of Chapter VI, which should be 'Hourglass Stomach'. It is not the contraction which is hourglass, but the stomach.

This is undoubtedly a book of reference with which every consultant should be familiar, and which everyone who is interested in the diagnosis and medical treatment of ulcers should read. Those parts which deal with pathology and diagnosis are excellent. Indeed, the only section of the book which we cannot welcome is that which deals with surgical questions, upon which neither of the distinguished authors can be regarded as an authority.

Rendiconto Clinico-operativo. Edited by Dr. G. NOGARA and Dr. G. POZZI. Super royal 8vo. Pp. 929 + xxxii, with 61 illustrations. 1929. Milan: Poligrafica degli Operai.

THIS handsome volume contains the Reports of the Institute of Clinical Surgery of the University of Milan for the years I to VI of the Fascist era. So full and complete an account of the whole 9556 cases treated in those years is made possible by the munificence of a citizen of Milan equally appreciative of the glory of the epoch. It is impossible to 'review' such a mass of material, but it may be said at once that as a work of reference for statistical purposes it should be a mine of wealth. It includes, apparently, every case treated in Professor Baldo Rossi's service, and though there are many contributors to the various sections, which are regionally arranged, one spirit and one method characterize the whole. A general section of fifty pages by Dr. Nogara details the methods employed for the investigation and control of diabetics needing operation; for the estimation of the efficiency of the respiratory, circulatory, uropoietic, and hepatic functions; for investigating the blood values and for performing transfusion; for inducing anæsthesia, and so on. Spinal anæsthesia is much employed (30,000 cases in about twenty-five years), preferably with a mixture of stovaine and novocain. They note that when used for operations above the umbilicus collapse is apt to occur about fifteen or twenty minutes after injection. The accidents met with have been transient and comparatively trivial. In the section on the head very detailed reports are given of fourteen cerebral tumours and of several exceptional tumours elsewhere, such as a cystic adamantinoma of the jaw, and rare growths of or associated with the salivary glands. Such reports throughout are made the basis of extensive discussions of the pathology, diagnosis, and treatment of similar cases from the literature.

Thoracic surgery, whilst not extensively practised, extends to all the types of lesion nowadays submitted to operation. Of the value of radium used after operation for cancer of the breast no estimate is at present expressed. It is interesting to see the trend of opinion in still another clinic towards dissatisfaction with gastro-enterostomy for ulcer, and to note that, as elsewhere, the end-results of gastrectomy for cancer are very disappointing. A patient with sarcoma of the stomach operated on in 1922 is still alive and free from signs. A very ingenious detachable forceps is employed for resections.

Throughout the section on the urogenital organs and the rectum the records are such as correspond with practice and experience in this country. The sections on fractures are well illustrated, and expose a practice, evidently very efficacious, rarely operative, and dependent upon the skilled employment of traction and plaster-of-Paris. Professor Rossi himself has paid great attention to the methods and mechanics of this treatment and has inspired his assistants with his own assiduity. The radiographs of results bear eloquent witness to their success. Particular attention should be directed to the ambulatory method of treating fractures of the femur illustrated on pages 823–832, and to the simple method for operative fixation of the fragments in fracture of the neck on pages 847–854.

The bare mention of these few features of the book gives no idea of the amount of work involved in this publication or of the intensive study of their clinical material reflected in the pages written by the staff of the clinic. As a whole, and in all its parts, the volume throws the greatest credit upon the dominating figure of Professor Rossi and upon the band of admirable clinicians he has gathered about him.

Surgical Diseases of Children. A Modern Treatise on Pediatric Surgery. By SAMUEL WALTER KELLY, M.D., LL.D., F.A.C.S., Member of the Senior Staff, St. Luke's Hospital, Cleveland, Ohio. Two volumes. Third edition, revised and enlarged. Royal 8vo. Pp. 1374 + xiv, with 615 illustrations. 1929. London: Henry Kimpton. Two volumes, 63s. net.

THE fact that this is the third edition of Kelly's *Surgical Diseases of Children* testifies that the book has met with approval, and that it has occupied a prominent place in surgical literature. The present edition embraces two volumes, and the plan of arrangement is that the first volume deals with matters of general interest, while the second is devoted to what may be termed regional considerations.

The first volume is somewhat disappointing; it gives the reader the impression that it has not received the same amount of attention as has been devoted to Volume II, and there are numerous references to matters which seem scarcely relevant at the present time. The value of Volume I would have been enhanced if it had been submitted to some discriminate pruning. We have sympathy with the author in this matter; elimination is a supremely difficult task, because so much of the context has established such a degree of familiarity that it seems to savour of treachery to abandon it, and yet, if successive editions are to maintain the standard of the original, replacement is inevitable. It is perhaps this criticism which explains certain figures tabulated on page 25 under the heading of anæsthetics, where it is recorded that the operation for double hernia in a child of fourteen months occupied one hour and forty minutes, and that pyloric stenosis in an infant of three months (a lesion presumably congenital) was treated by gastro-enterostomy, an operation of fifty minutes' duration.

The section on blood transfusion is helpful and inclusive, but it is a pity that no mention is made of immuno-transfusion. In discussing the biochemical aspects of post-operative acidosis it is stated that "the blood is acid, or, more correctly speaking, diminished in alkalinity, as shown by the phenolsulphonephthalein test." This estimate is unlikely to be acceptable to the biochemist of to-day.

The introduction, comprising sixty pages of the book, is concerned with the "general surgical pathology of the developing period." It is difficult to understand the principle upon which this grouping is arranged, for it includes such widely differing conditions as acromegaly, hydatid cyst, chloroma, and tumours of bone. Taken as it stands, the information is moderately satisfying, though there are certain statements which demand challenge, such as "pressure on the chiasm produces optic neuritis"; "In cases of sarcoma of an extremity early and thorough removal may succeed in eradicating the trouble, but it is apt to be followed by recurrence necessitating final amputation"; and again, "The presence of Bence-Jones proteinuria confirms the diagnosis of sarcoma, or at least of myelogenous disease." These points are stated with dogmatic assurance, and yet it is obvious that they demand considerable qualification.

The second volume is a more satisfying production. It presents the surgical problems of childhood on a regional basis, and it does so in an inclusive and attractive way. Modern views have received due consideration, each subject is treated in logical sequence, and it is pleasant to find the author discussing his subject on a basis so essentially clinical and personal.

Even in Volume II, however, there is much which is open to criticism. Birth injury of the brachial plexus is discussed, and after a short description of the conservative treatment of this disability, Kennedy's operation is detailed and apparently supported by the author. The operation was described twenty-seven years ago; it implies exposure of the plexus, the excision of damaged nerve tissues, and end-to-end suture. The results have been uniformly disappointing, and it is doubtful if the method is ever practised at the present day. The real objections to the method are that, if nerve division has occurred, the site of rupture is so close to the spinal column that suture is impossible, while, if there is stretching without avulsion, conservatism offers better results than suture.

Poliomyelitis, a subject of such vast interest and importance in pediatric surgery, is unconvincingly treated. Recent research has shown that the three weeks' quarantine recommended by the author is insufficient. It is also probably incorrect to say that "it attacks the entire central nervous system and also its meninges." The statement that "there is said to be very little danger of death from this disease" is surely unduly optimistic, for epidemic types are often associated with a heavy mortality.

More careful proof-reading would have eliminated the unfortunate lines (page 725) "after the joint is opened with a knife, gouge, or Volkmann spoon, the cartilage or a portion of it is removed". Soutter's operation for correction of flexion deformity of the hip is insufficiently and even incorrectly described.

The chapter dealing with the spinal column is unsatisfactory, and in future editions it would be well to revise in detail the pathology and treatment of scoliosis.

In discussing the treatment of congenital stenosis of the pylorus it is doubtful wisdom to allude at such length to the operation of gastro-enterostomy, and when the description includes the recommendation, "The anastomosis completed, a catheter may be passed per oreum through it, and a dose of water placed in the intestines before closing the abdomen", we are inclined to doubt whether these volumes are as personal in their experience as we originally thought.

But let us have done with criticism! It is a vast task to compile and to write thirteen hundred pages of description, and the author is to be congratulated on the success of much that he has accomplished. The binding, printing, and paper are excellent, many of the illustrations are good—some might with advantage be omitted and replaced by informative diagrams.

The Mobilization of Ankylosed Joints by Arthroplasty. By W. RUSSELL MACAUSLAND, M.D., Surgeon in Chief, Orthopedic Department, Carney Hospital; and ANDREW R. MACAUSLAND, M.D., Orthopedic Surgeon, Carney Hospital, Boston, Mass. Medium 8vo. Pp. 252 + vii, with 154 engravings. 1929. Philadelphia: Lea & Febiger. $4.00 net.

THIS work collects in a small space an account of the methods of arthroplasty used by the authors and by pioneers in various countries. The attitude towards arthroplasty is, perhaps, rather an optimistic one. In spite of the statement in the Preface that arthroplasty has become a standardized form of treatment in the mobilization of ankylosed joints, one cannot but feel that in the case of most of the joints the work is still largely experimental in character, and that it is extremely difficult to foretell the functional result that will be obtained by operation in any individual case. But for this very reason, such a really extensive collection of literature, put together by surgeons who have also a large amount of practical experience themselves, is valuable.

If there is one criticism that may be made it is that perhaps insufficient attention is paid to the indications for arthroplasty in the case of each joint, and to the way in which the prognosis after operation is affected by the pre-operative condition. It is well known that the joints upon which it is best to perform an arthroplasty to obtain a good result are usually those with a sound ankylosis in a good position following some acute infection—just those cases in which most conservative surgeons are apt to advise the patient to leave the joint as it is. Arthroplasty is more difficult in cases of unsound fibrous ankylosis, and in cases in which there is a bad pre-existing deformity.

The work is very well written, printed, and illustrated, and will be used as a work of reference by those practising joint surgery.

Radium Practice, 1929. Edited by ROCK CARLING and the *Westminster Hospital Reports* (Vol. XXI) Editors, STANFORD CADE and DONALD PATERSON. Demy 8vo. Pp. 258 + viii, with 12 illustrations. 1929. London: H. K. Lewis & Co. Ltd. 7s. 6d. net.

THIS book outlines the current methods of radium treatment at the Westminster Hospital, and embodies the course given there in July, 1929, by the staff, nineteen of whom contribute to this volume. There is an excellent introduction to some physical aspects of radium, and the rest of the book is devoted to methods of application, with notes on the 'follow-up' cases shown, and the operations performed during the course.

That radium therapy during the last few years has made great progress is shown by the statement, made here by a surgeon, that even in operable cases of carcinoma of the tongue, radium will entirely obviate the necessity of excising the primary growth. This, moreover, is the trend of opinion expressed throughout the book, except in connection with the treatment of operable carcinomata of the rectum, where excision is still held to be the method of choice.

Now that radium is a definitely established part of the surgical armament, it is necessary to fix its true value, and this may be achieved best by comparing the considered opinions of groups of men engaged in radium therapy. This volume

emphasizes the value of team work, which is clearly illustrated by the descriptions of biochemical investigations employed to check the results of radiotherapy, and the importance of repeated blood-counts upon those who are exposed to irradiation. As the minimum screenage necessary for interstitial irradiation 0·5 mm. of platinum is accepted, and small doses of radium over a long period of time are considered to produce the best results, while radon, which is said to involve greater technical difficulty of uniform distribution, and with which it is suggested that it is necessary to commence with an overdose to obtain an adequate total dose, is not used. There is much in this book to interest both radium workers and surgeons, and the authors are to be congratulated upon the wise attitude of caution which they have adopted.

Regional Anæsthesia. Its Technique and Clinical Application. By GASTON LABAT, M.D., Clinical Professor of Surgery, New York University and Bellevue Hospital Medical College, etc. With a Foreword by WILLIAM J. MAYO, M.D. Second edition, revised. Royal 8vo. Pp. 567, with 367 original illustrations. London and Philadelphia: W. B. Saunders Co. 35s. net.

WE welcome a second edition of this book, which is probably the best work upon the subject of regional anæsthesia, and we prophesy a success for the new edition similar to that which attended the first appearance of the work. In it the surgeon, the first assistant, or the anæsthetist will find everything that is necessary for the successful practice of the art of regional anæsthesia.

In discussing the technique of splanchnic analgesia the author still prefers the posterior route first suggested by Kappis and modified by himself, regarding this method of access as the safest, simplest, and most certain. His experience hardly coincides with that of the Austro-German school, Finisterer, von Haberer, Clairmont and others all employing the anterior method of Braun; and in those few English clinics where splanchnic anæsthesia is employed, either alone or with light general narcosis, the posterior method has now been abandoned and the anterior route is exclusively used.

In this second edition the chapter on spinal anæsthesia has been largely rewritten, and the writer appears now to exhibit a predilection for the subarachnoid block in cases where formerly he advocated regional or paravertebral anæsthesia, and in his opinion the subarachnoid block is indicated in all operations below the diaphragm, "when the other procedures of regional anæsthesia cannot be induced successfully or are likely to fail." In our view the use of regional anæsthesia and splanchnic block constitutes a far safer form of anæsthesia for upper abdominal cases, and is perhaps best utilized in conjunction with gas and oxygen or light general anæsthesia. In this way the Crile principle of 'anociation' is carried one step further forward, for the splanchnic block is but an additional form of regional anæsthesia.

The author employs novocain, or rather the French brand, néocaine; our own recent experience with percaine has convinced us of its marked superiority over the drugs just mentioned, and for abdominal work it has been found that the analgesia produced with percaine lasts longer and is not associated with the fall of blood-pressure symptoms seen in cases where novocain has been the drug employed.

The illustrations are clearly delineated and most helpful, but a few of the recent additions are not quite up to the uniformly high standard of the rest of the figures.

Diseases of the Thyroid Gland. By ARTHUR E. HERTZLER, M.D., Surgeon to the Halsted Hospital. With a chapter on Hospital Management of Goiter Patients by VICTOR E. CHESKY, M.D., Associate Surgeon to Halsted Hospital. Second edition, entirely rewritten. Royal 8vo. Pp. 286, illustrated. 1929. London: Henry Kimpton. 32s. net.

IN the preface to the second edition of this book—which has been entirely rewritten—the author again emphasizes the statement that his isolation has enabled him to work untrammelled by the opinion of others, and has given him the opportunity of observing his patients over long periods, many of them for more than thirty years. The second reason is a sound one, and the book bears much evidence of its value;

whether the first reason is as important as the author believes is open to doubt. The informed opinion of others is a healthy corrective to one's own ideas, and the statement itself is rather belied by the intimate knowledge shown of the most recent literature on the subject. One statement in the preface, that the chief difference in technique from that given in the first edition is that now 'no' partial resections are done, scarcely marches with that on page 70 about " fulminating cases which go on to a fatal termination before they can be prepared for operation ". The use of iodine has increased the safety of operation, and frequently this may be completed in one stage, but there are still many patients intermediate between those in whom this can be done and the fulminating cases where the author states that operation cannot be contemplated.

Apposite epigram and dogmatic statement make the book extremely entertaining, but these occasionally are built on half rather than whole truth. The work is modern in outlook. Leaving out of consideration for the moment malignant change, enlargements of the thyroid gland are regarded as one entity, the author frequently writing of 'the disease'. He emphasizes the fact that in most cases this is extremely chronic, and only those can arrive at fair conclusions who are able to observe their patients for long periods, or throughout the course of the disease. The study therefore is eminently one for the family doctor whose life is part of that of his patients. The author insists repeatedly on the tendency of the disease to advance from the comparatively innocent to the more serious forms, and in the classification adopted he states that these classes do not represent separate diseases, but merely stages—at least for the most part—of one progressive disease. " Naturally the change does not take place overnight, but may require years, even decades." This being so, it is not possible to regard an enlarged thyroid as negligible in its earlier stages. This does not mean that operation should be performed in the early stages, and due prominence is given to the fact that the simpler forms frequently respond to appropriate treatment. From thirty-five years' observation in the one district, Hertzler believes that a goitre which has not been cured early sooner or later kills the patient, unless some intercurrent disease anticipates this end. " Timely operation in goitre is as important as timely operation in cancer. Doping goitres of certain well recognizable types with medicine rivals in wisdom the application of salve in cancer of the breast." On the other hand, he indicates strongly the harm done in operating upon psychasthenic patients whose symptoms are not attributable to the thyroid.

The author well points out the infrequency of auricular fibrillation in young patients, even in severely toxic cases, while in those past middle life fibrillation is common with much less toxæmia. For the foregoing reasons he speaks in no uncertain voice about the wisdom of early and adequate operation once the disease is established, being convinced through living a long life in intimate association with his patients that this completely cures, and that the cure is incomplete only when operation has been delayed too long. In this respect the author states that the removal of an adequate amount of thyroid tissue is a relatively recent accomplishment. In American literature it is generally ignored that this was insisted upon in British literature in 1908, and repeatedly in the years immediately following. Notwithstanding the insistence placed on the single entity of the disease, Hertzler states that he agrees with Plummer that a sharp division should be made between true Basedow's disease and the supertoxic colloid goitre. This is scarcely in accord with the trend of modern thought, or indeed with the author's own views repeatedly expressed throughout the book. Everyone will agree in appreciating both the great service rendered to goitre surgeons by Henry Plummer, and the tribute paid to him by the author in dedicating the volume to him.

For toxic goitre hospital management (in a chapter by Dr. Chesky) and an operative technique are well described. Local anæsthesia is used almost exclusively at this clinic. Not everyone will agree that sharp dissection throughout is the wisest practice ; and most surgeons now follow Lahey in using lateral in preference to median drainage. These are matters of individual preference. The incision illustrated to give easy approach to a unilateral goitre is never required ; any deviation from the collar incision gives a conspicuous scar. With regard to the

parathyroids the author states that "we pay no heed to these little glands, and we have no tetany." If this were the universal experience, surgeons who operate upon the thyroid gland would be relieved of one of their greatest anxieties.

The author believes that nine out of every ten cases of carcinoma of the thyroid gland develop from fœtal adenomas. The difficulties of diagnosis both histologically and clinically are well set forth, but it would not be safe to accept the statement that "for surgeons it is more convenient to regard those tumours as benign which, though showing microscopic evidence of malignancy, have not perforated the capsule." There have been too many instances where the subsequent history has confirmed the pathologist's judgement. Few will agree that "problems [of malignancy] must be settled at the operating table; a study of slides alone cannot decide them." On study of the slides may depend the patient's life. Although the ultimate prognosis is bad, the author does not appear to realize the extent to which life may be prolonged in many instances by the use of X-ray treatment following operation, even when local spread has been extensive.

There is apparently no reference to the condition known as woody thyroid, or Riedel's struma. *Fig.* 52, taken from a patient with a B.M.R. of −3 and who was not improved by operation, is singularly like a section from the early stage of a woody thyroid. Apart from this, the subject is covered very thoroughly. The illustrations are numerous, well chosen, and well reproduced. These, together with the lucid style, make the author's meaning everywhere clear. On a subject embracing so many aspects which are still unsettled there must be differences of opinion; bearing this in mind, the book is good, and it is extremely entertaining.

Stone in the Urinary Tract. By H. P. Winsbury White, M.B., Ch.B. Edin., F.R.C.S.E., F.R.C.S., Assistant Urological Surgeon, St. Paul's Hospital for Genito-urinary and Skin Diseases. Large 8vo. Pp. 344, with 181 illustrations in the text and 2 coloured plates. 1929. London: J. & A. Churchill. 25s. net.

Monographs on this subject are not very common, and we looked forward to reading what the author had to say on stones in the urinary tract and their treatment. We may say at once that there is not very much new in this book, but that it contains an excellent and up-to-date account of our present knowledge of urinary stone. The illustrations are uniformly excellent and well reproduced; indeed, the volume is quite worth buying if only for the beautiful pictures of stone in the kidney and ureter and for the skiagrams; many of them would make first-rate lantern slides for purposes of lecturing.

The urological surgeon will naturally turn first to those parts of the book which deal with problems on which there is still some difference of opinion. Whilst the author has nothing original to give us on the theories of stone formation, there is a most interesting account of the actual process of formation in the kidney and ureter. He points out that stones tend to grow against the stream of urine; thus if the nucleus of a stone lies in the pelvis of the kidney, the later extensions will grow into and fill the calices; in the same way, the nucleus of a ureteric calculus will always be found at or near its lower end.

Another point of some practical importance is the significance of the cessation of growth in a kidney stone; this the author looks on as a sign of ill omen, for it is probably due to the absence of any urinary excretion and means the destruction of the renal cortex. An even more striking statement is that "it is of value to remember that a kidney damaged by stone or by the operation necessary to remove it will resume its function if the other kidney is insufficient for any reason. If the other kidney is perfectly normal, the damaged one will not regain its function after operation." If this is true, and it sounds quite reasonable, nephrectomy for stone in the kidney should be performed much more often than it is; unfortunately, the author gives us nothing in the way of proof, and not even a reference in case we should feel inclined to look into this question a little more closely.

In the treatment of stone in the bladder Mr. Winsbury White is an ardent advocate of lithotrity—rightly so, we think, for the mortality is astonishingly low and this method of treatment is admirable from the point of view of the patient

and also from an economic standpoint; we often wonder why the operation has not become more popular. However, the writer is so carried away by his enthusiasm for the crushing operation that he omits to give any description of suprapubic lithotomy, though he mentions that the choice has to be made between these two procedures.

There is a good index and a very extensive bibliography of everything published from 1910 to 1928, covering nearly seventy pages, and including English, American, French, German, Italian, Dutch, Russian, and Scandinavian sources; this would be more useful to the general reader if it were provided with a separate index, especially one of the authors' names.

On the whole, we consider this a very useful monograph, and we commend it to our readers. For the benefit of future editions, we point out that on page 16 the reference to *Fig.* 160 should be altered to *Fig.* 162; on page 37 the figures referred to as 163 and 164 are obviously misnumbered; on page 115 reference to *Fig.* 89 shows a huge ureteral stone, but no ureteral catheter pointing to it as one would expect from the text.

If it were possible to rearrange the book, it would add greatly to the comfort of readers if the illustrations could be made to face, at any rate roughly, the page on which they are referred to; it is exasperating when reading page 189 on the treatment of vesical stone to have to turn back some thirty-nine pages to find *Fig.* 103; indeed, the reader is likely soon to cease to take the trouble to do so; some of the figures might well be given twice.

Lastly, one other point which we approach with diffidence; we think the author's habit of over-emphasis defeats itself; one sentence is given as an example: "A well-lubricated *forefinger* slowly introduced into the *rectum* while *the other hand* gently compresses the *suprapubic region*", etc. We humbly suggest that this irritating underlining does not allow sufficiently for the average reader's intelligence.

The Treatment of Varicose Veins of the Lower Extremities by Injections. By T. Henry Treves-Barber, M.D., B.Sc. Crown 8vo. Pp. 120, illustrated. 1929. Bristol: John Wright & Sons Ltd. 6s. net.

So much has been written about the treatment by injections of varicose veins that in a new book on the subject one naturally looks for something new; but apart from a description of a new needle and the use of an unusual solution, there seems nothing that is new in this book.

Under the heading of etiology the author classifies the causes into congenital, hereditary, and acquired; whereas on the pathological side he divides varicose veins into three separate groups—namely, primary varicose veins, secondary or acquired varix, and dilated veins. The latter are purely symptomatic and are due to a compensatory circulation. The importance of deciding into which group veins fall before commencing treatment and giving a prognosis is emphasized. The importance and use of the 'breathing' test, in which the veins dilate on inspiration and contract on expiration, thus demonstrating the incompetency of the valves, is urged. In the chapter on complications of varicose veins we find it difficult to agree that talipes equinus is a not uncommon complication in long-standing cases of varicose veins.

The author favours the use of sodium chloride as a sclerosing agent. He uses a 15 or 20 per cent solution and gives up to 20 c.c. of the latter. He makes a good case for the use of this salt in preference to others. A needle with a lateral eye just proximal to the point is advised since it brings the solution more closely into contact with the endothelial lining of the vein, and by rotation the solution can be made to impinge on the whole circumference of the vein.

A chapter is devoted to varicose veins and puerperal septicæmia, and the author believes that not only is puerperal septicæmia a common cause of phlebitis, but also that it may originate from a phlebitis which has been present before the pregnancy.

The most obvious deficiency in the book is the absence of records of cases. If the author had given the numbers of cases cured, improved, or not in his own series, and if the numbers of cases of the various complications had been given, the value

of the work would be increased. Throughout the book a number of rare words such as lipothymia, anamnesis (a Continental term), saphenectomy, hæmatolytic, and epidermoplastic are used. Simplicity in the choice of words might be preferable.

The Injection Treatment of Varicose Veins. By A. H. DOUTHWAITE, M.D., F.R.C.P. (Lond.), Assistant Physician to Guy's Hospital. Fifth edition. Crown 8vo. Pp. 58 + x. 1929. London: H. K. Lewis & Co. Ltd. 4s. net.

WITHIN two years this little book has reached its fifth edition. A little has been added in each issue, and in the latest there is a new account of the microscopical changes produced by sclerosing solutions in a varicose vein. We are surprised to find that the author still advises that an enema should be given before injecting hæmorrhoids. We still feel, as in our review of the first edition, that it would be very helpful if the author gave fuller details and statistics of the results, complications, and failures in his series of cases, which should now be sufficient in number to record. The book is a simple introduction to the treatment by injection of varicose veins and can be recommended to the beginner; but no account of the direction in which it is best to put the needle in the vein is given.

Hæmodynamics. The Mechanism of Venous, Capillary, and Lymphatic Flow; Œdema; and Injection Treatment of Varicose Veins. By P. B. KITTEL, F.R.C.S., Assistant Surgical Officer at the Royal Northern Hospital, London. Crown 8vo. Pp. 196 + xi, with 3 plates and other illustrations. 1929. London: H. K. Lewis & Co. Ltd. 10s. net.

A BOOK of nearly two hundred pages on a subject such as hæmodynamics seems rather formidable and at first unnecessary, but with the treatment of varicose veins by injection so much to the fore as it is at present it is important that all the phenomena of venous and capillary flow, of the action of valves, of compensatory dilatation, and of œdema should be understood. Many points about these subjects which are very clearly set out by the author from a simple physical point of view are realized for the first time.

The author's experience is gained from 446 cases of varicose veins. The last part of the book is devoted to treatment. After many cases had been treated with quinine and urethane, sodium salicylate, and saline borocaine, the author commenced using sodium morrhuate in a 5 or 10 per cent solution. By accident, when injecting the drug intravenously for tuberculosis, he found its sclerosing properties, and now prefers it to any other solution. He only refuses to treat varicose veins on two counts, decrepitude and swelling of the legs. He does not appear to rank phlebitis as a contra-indication to treatment by injection.

The book concludes with an extensive and very interesting list of statistics of results of the author's 446 cases.

Westminster Hospital Reports. Edited by STANFORD CADE and DONALD PATERSON. Vol. XX, 1924–1928. Demy 8vo. Pp. 343 + viii, illustrated. 1929. (Published October.) London: H. K. Lewis & Co. Ltd. 7s. 6d. net.

THE lively interest in the problems of radium therapy which is being shown by the staff of the Westminster Hospital is common knowledge; but the publication of the Hospital *Reports* for 1924–1928 testifies to the efficiency of the work done in the wider fields of medicine and surgery. In addition to the usual statistical tables, the volume contains ten original articles, only one of which deals with radium, and this is in the nature of a statistical inquiry.

Sir James Purves-Stewart gives an account of his method of pneumo-radiography in the diagnosis of cerebral tumours, with case histories and clear reproductions of skiagrams to illustrate his argument. He does not dwell upon the dangers of the procedure or upon the relative merits of alternative methods of carrying out ventriculography. This is followed by an extremely valuable survey by Mr. Rock Carling of twenty-four patients treated by periarterial sympathectomy. He considers the operation to be of value in the treatment of Raynaud's disease, acrocyanosis, and intractable ulcers; but the results were disappointing when endarteritis was present, or when pain was the only reason for operating.

Dr. Adolphe Abrahams contributes an interesting article on "Exercise and the Cardiac Rate" in which he shows that poor response to exercise in cases of 'effort syndrome' is to be related more to a general lack of co-ordination in the body as a whole than to any disease of the heart. In a paper on "Cataract" Mr. A. F. MacCallan makes a plea for the elimination of focal sepsis wherever it may be found in all cases of early lenticular opacity, since chronic focal sepsis is in his experience the only constant accompaniment of the changes in the eye leading to cataract formation, and to neglect the condition till it is well established means irreparable damage to the lens.

Dr. Allchin gives an account of six cases of lymphadenoma treated by X rays, and Dr. Dunlop describes some significant experimental work on the effect of ether anæsthesia on the action of adrenalin upon the circulation.

There are three papers dealing with uncommon diseases: "A Case of Mycosis Fungoides" by Dr. S. E. Dore and Dr. H. Thompson Barron; "A Case of Cysticercus Cellulosæ of the Brain in a Human Subject" by Dr. Braxton Hicks; and an exhaustive study of six cases of Werdnig-Hoffmann paralysis by Dr. Donald Paterson. The last paper is particularly important, and is illustrated by a series of excellent drawings and photographs of patients and microscopical preparations. The author inclines to the view that Werdnig-Hoffmann paralysis and Oppenheim's disease have the same pathological basis; a comprehensive bibliography is appended.

The radium article by Mr. Rock Carling and Mr. Stanford Cade gives in tabular form an account of the clinical condition, method of application of radium, and the result of treatment in 190 patients. To all those who are working at the surgical applications of radium this contribution will be of much value; and only those who have attempted to follow up and criticize their own work will appreciate the labour which the compilation of this table must have entailed, and the high standard achieved by its authors.

The latter half of the volume consists of an abstract of the post-mortem examinations carried out from 1924 to 1928, a catalogue of specimens added to the Museum during that period, and the report of the Pathologists and Registrars. Though all these returns contain much that is of interest, no special comment is called for. It may fairly be stated that Volume XX of the *Reports* is a production upon which the editors and the staff of the Westminster Hospital are to be congratulated.

Collected Papers of the Mayo Clinic and the Mayo Foundation. Edited by Mrs. M. H. Mellish, Richard M. Hewitt, M.A., M.D., and Mildred A. Felker, B.S. Vol. XX, 1928. (Published June, 1929.) Medium 8vo. Pp. 1197 + xx, with 288 illustrations. 1929. London and Philadelphia: W. B. Saunders Co. 60s. net.

In the compilation of the twentieth volume of this series, 429 papers were considered, Of these "eighty-one are reprinted, forty-three are abridged, seventy-two are abstracted, and of 233 references only are given." This shows that a lapse of twenty years has seen a great change in the character of the volume, which at first contained all the publications of the Clinic. It is obviously wasteful in every sense to reprint a paper the value of which is limited owing either to the scope of its subject or the narrowness of its appeal. In fairness to the literary activity of the Clinic, it must be recognized that this volume in no way represents the total of their output.

Drs. Walter C. Alvarez and W. C. MacCarty, from a study of the size of over 600 resected gastric ulcers, reaffirm MacCarty's statement that any chronic gastric ulcer with a crater more than one inch in diameter is probably cancerous, but if smaller than this, the chances are ten to one that it is benign. Kirklin's paper on the X-ray recognition of duodenitis draws timely attention to a condition which is usually mistaken for, and treated as, actual duodenal ulceration. The same author contributes a moderate and very well-balanced appraisal of cholecystography. He concludes that it possesses a diagnostic excellence at least equal to that of accepted tests for other diseases. The enormous experience of surgeons in the Clinic is shown by Waltman Walters' paper on strictures of the bile-ducts: of 17 operations for benign stricture, no fewer than 13 followed cholecystectomy.

From the large number of contributions relating to surgery of the colon, it is evident that several members of the Clinic are interested in this branch of surgery. F. W. Rankin contributes an account of a considerable piece of work in which he endeavours to carry out an aseptic method of intestinal anastomosis. From the written and pictorial description of his procedure it is difficult to make certain that one grasps every detail. It is clear that the risk of contamination of the peritoneum from the divided ends of the bowel is, if not absolutely excluded, certainly reduced to a minimum ; but in every case of actual anastomosis a suture is employed, and one cannot help wondering whether the author has overlooked the fact that, as Halsted showed, it is impossible to introduce this suture without encroaching upon layers of the intestinal wall, from which infection may proceed.

The surgery of the sympathetic system is still in its infancy. The paper by Judd and Adson on lumbar sympathetic ganglionectomy and ramisectomy for congenital idiopathic dilatation of the colon shows how successful this treatment was in two cases The description of the technique is lucid, and is much assisted by a most beautiful drawing by R. Drake. Diseases of the thyroid occupy a smaller proportion of this volume than in some of the former numbers, but a comprehensive review of the present state of our knowledge of the pathology of thyroid diseases is afforded by Walter M. Boothby's paper read before the Medical Society of Sweden on the thyroid problem. The credit of the application of phrenicotomy in the treatment of diaphragmatic hernia must be given to Stuart W. Harrington. It is used either as a palliative procedure or as a preliminary to radical treatment. The article is exceptionally well illustrated.

In the preceding remarks attention has been drawn to a few of the papers which appear to the reviewer to be of outstanding merit, of general surgical interest, or which are, probably, upon subjects in which he himself is interested. There are, of course, many other articles, of which any one interested in a special line of surgery must have cognizance. Some of the most important contributions of the year are only referred to in abstract. It will not be questioned that while one surgeon who is interested in one branch will read one set of papers, and another will make a different selection, all who open this volume will be attracted to the writings of Drs. W. J. and C. H. Mayo on general subjects, particularly to the former's paper on " The Advancement of Learning in Medicine through Biochemistry." It is full of evidence of wide scientific knowledge, and it is no mean feat of this author to have been able to interest the American Chemical Society in the application of chemistry to modern medicine. But the plum of the whole volume is Dr. Louis B. Wilson's biography of William Worrall Mayo. As a statement of unadorned fact it is a model of what such a paper should be. Admittedly, Dr. Wilson had as his subject a most fascinating personality—a pioneer in a new country with a highly scientific mind. Every reader who retains a fragment of the spirit of boyhood must be fascinated by Dr. Mayo's adventures, and filled with admiration for his personality. One doubts whether medical history can afford a parallel in which so great a father has produced two such eminent sons.

St. Bartholomew's Hospital Reports. Edited by Sir THOMAS HORDER, Bart., K.C.V.O., RONALD G. CANTI, WILFRED SHAW, W. LANGDON BROWN, W. GIRLING BALL, and GEOFFREY EVANS. Vol. LXII. Demy 8vo. Pp. 262 + xxv, illustrated. 1929. London : John Murray. 21s. net.

A LARGE portion of this volume is occupied by very ample papers on the dietetic treatment of various medical disorders. Several of these, such as that dealing with diabetic coma, should be helpful to surgeons treating the surgical complications of such a disease. Professor Gask contributes a paper on diverticula of the duodenum, which he concludes have little clinical significance. Sir Charles Gordon-Watson discusses the treatment of cancer of the rectum by radium from all possible aspects ; one gathers that at present he does not make use of it in preference to accepted operative measures. Sir Frederick Andrewes reviews recent work on hæmolytic streptococci, and though most of this concerns strains from scarlet fever cases, he points out that other streptococci, such as that of erysipelas, present close analogies.

Drs. Maxwell and Nicholson write on the incidence of primary malignant intrathoracic new growths, and from an analysis of post-mortem records for the past sixty years argue that it has increased considerably since the War, though they are unable to assign any cause for this.

Devils, Drugs, and Doctors. The Story of the Science of Healing from Medicine-Man to Doctor. By HOWARD W. HAGGARD, M.D., Associate Professor of Applied Physiology, Yale University. Medium 8vo. Pp. 405 + xxii, illustrated. 1929. London: William Heinemann Medical Books Ltd. 21s. net.

IN spite of its catchpenny title, which after all is only a reversal of that given to one of his pamphlets by John Alexander Dowie, the faith healer, this book is well worth reading. Dr. Haggard is the Associate Professor of Applied Physiology at Yale University, and he writes therefore with a sound knowledge of his subject and a corresponding sense of responsibility. The work is intended primarily for the general public, though it may be studied with pleasure and profit by a medical man. It is based mainly upon the work of Ambrose Parey, who is clearly a hero to Dr. Haggard. The first section deals with "The Conquest of Death at Birth". It treats of various birth customs and shows the advance made by Parey when he recommended podalic version. The work of Oliver Wendell Holmes and of Semmelweis in reducing the mortality of childbed, and that of Sir James Y. Simpson in lessening its pain, are adequately described, and the author then passes on to the progress of surgery. He tells how anatomy was taught, and in doing so makes the curious mistake of confusing the ordinary manuscript contraction for *orum* for the ℞ which heads a Latin prescription to this day. It is rather difficult to decide in the chapter "The Greatest Surgeon" whether Dr. Haggard considers Parey or Lister is to be preferred to that honourable position. Plague, pestilence, and famine are duly considered, and there is some very plain but necessary speaking about prostitution and syphilis on the broad lines of common sense. Finally, faith healers, chiropractics, *et id genus omne* are considered, and Dr. Haggard thinks that they would be less flourishing if the medical profession adopted a more sympathetic attitude towards minor and imaginary ailments. There are a few small mistakes which might be corrected in future editions—for instance, Lister does not lie in Westminster Abbey (p. 170), although a stately burial service was held there. Thomas Gale (p. 134) should not be Thomas Gales. John Ward was Vicar of Stratford-on-Avon after the Restoration, which was in the seventeenth, not the fifteenth century (p. 188). Philippe Record should of course be Ricord (p. 252). Bayle is wrongly indexed in two places, but in each Robert Boyle is probably meant.

The illustrations add much to the book, and there are some pretty initial blocks for the capital letters showing scenes from a dance of death.

Les Accidents de la Cholecystectomie. By SERGE HUARD, Ancien Interne des Hôpitaux de Paris. Preface by Dr. ANSELME SCHWARTZ, Professeur agrégé à la Faculté de Médecine de Paris. Medium 8vo. Pp. 116 with 17 illustrations. 1929. Paris: Masson et Cie. Fr. 16.

THIS is a very interesting little book which deals aptly with the various accidents that may attend the operation for removal of the gall-bladder. The normal and abnormal anatomy of "la région des voies biliaires" is carefully described and illustrated, much care being devoted to the anomalies of the vessels. An interesting section deals with pathological anomalies, and there are some good diagrams. Having shown that anomalies of one kind and another are fairly common, Huard contends that the success of the usual methods of removing the viscus depends more on the watchful care of the operator than the suitability of the technique. A new technique is described which the author associates with the name of Professor Schwartz and himself. The main feature appears to be the separation of the gall-bladder from the liver in the middle of its attachment, the structures in the gastro-hepatic omentum being then pushed downwards and inwards so that the cystic duct is exposed from above. There is nothing in the description or in the diagrams

which accompany it to suggest that any less care is necessary with this than with the other and more familiar methods. There is a brief summary of no fewer than seventy reported cases of the various injuries that have followed cholecystectomy. Several cases from the British literature are not included, and similar omissions mark the otherwise comprehensive bibliography.

Radium and Cancer (Curietherapy). By DUNCAN C. L. FITZWILLIAMS, C.M.G., M.D., Ch.M., F.R.C.S., Senior Surgeon and Lecturer in Clinical Surgery, St. Mary's Hospital, etc. Demy 8vo. Pp. 172 + vii, with 80 plates (4 coloured) and 64 illustrations in the text. 1930. London: H. K. Lewis & Co. Ltd. 12s. 6d. net.

IN the present state of radium therapy in Great Britain any record of the methods adopted by a surgeon who has considerable experience must be valuable. This book is such a record, and claims to be a guide only " to those whose supply of radium is . . . limited ". Its general plan follows closely that of a somewhat earlier and already well-known book. The author does not attempt to disguise the very elementary—'elemental', he says—state of our knowledge of the problems involved; he speaks with proper hesitancy as to dosage, choice of method, and spacing of treatment, even if here and there he seems surer that others are wrong than that he himself is right. " Successes ", he says in the introduction, " are what we expect ", and no doubt that is the correct attitude to adopt when trying out any new attack on cancer. The published percentage of cures from the best sources about the most favourable types of cases are, however, so modest that cool expectations cannot be very high.

The chief defect of the book—excusable, of course—is that there seems to be no attempt at helping the tyro to visualize the fields around individual needles or groups of needles interstitially implanted, or delivered from plaques of surface application. Probably if the field were plotted from such an arrangement as the gridiron figured beneath the breast on page 79 it would lead the author to modify that particular technique. It is notoriously difficult so to implant needles as to secure a uniform irradiation of the full extent of a growth, and it is a pity in any way to minimize this point, for not everyone can attain the adroitness of the author, especially when implanting through such a tube as the sigmoidoscope, or approaching the tonsil from without.

The sections on oral cancer disclose nothing new in method or results. Metastases in cervical glands are dealt with by block dissection in all cases, with insertion of needles at the end of the operation. Diathermy, the author considers, should not be employed, as " infection of the glands must be more common after such a proceeding ". The author's views on the operative treatment of cancer of the breast are unorthodox. He carries his views, logically, into the use of radium. It is unnecessary to put needles above the clavicle or in the intercostal spaces, but on the other hand they should be " thrust into the chest at the anterior ends of the intercostal spaces . . . where the glands are situated ". This procedure seems not without danger. On the whole, the favourable view which is taken of the prospects of cure of cancer of the breast will, it is to be feared, raise false hopes both in the sufferers and surgeons.

The chapter on the rectum is tentative and it is not always clear exactly what the author intends by his directions. He is not afraid to use radium in a tube in the lumen at the same time that his interstitial needles are in position, nor to open the peritoneum when implanting from below without a preliminary colostomy. The sections dealing with the œsophagus and stomach reflect the present state of uncertainty and experiment everywhere prevailing. In speaking of cancer of the prostate it is stated that in early cases micturition soon becomes normal again as " the result of almost any kind of radium treatment ". This experience is happier than that of many other surgeons, who, it must be confessed, are not lucky enough often to meet with 'early' cases, except where the prostate already has been removed. Cancer of the bladder and penis is treated on usual lines; cancer of the larynx after the style of Harmer. In speaking of cancer of the thyroid it is stated that the trachea and laryngeal cartilages " may be protected with lead rubber tissues ",

but the method is not explained. With parotid tumours the author seems to have had success, reducing the growth to a cyst containing thick blood-stained fluid that can be easily evacuated. The chapter on the uterus and vulva is by Malcolm Donaldson and is everything that is to be expected from his great experience and facile pen.

The book is well illustrated, and the case records give an idea of the success Mr. Fitzwilliams has had in many fields with the use of radium. In another edition the author might, with a little trouble, make his meaning clearer and his directions more precise in a good many places. His proof-reader will no doubt correct 'glands' to 'glans' (p. 138 twice), and 'sewn' to 'sown' (p. 130).

Chirurgie des Os et des Articulations des Membres. By P. LECÈNE, Professeur à la Faculté de Médecine de Paris ; Chirurgien de l'Hôpital Saint Louis. With the collaboration of P. HUET, Chirurgien des Hôpitaux de Paris. Pp. 591, illustrated. 1929. Paris : Masson et Cie. Paper covers, Fr. 125 ; bound, Fr. 140.

THIS volume sets out to give a full account of the present practice of this branch of surgery for students who intend to become surgeons. It is practically entirely devoted to operative methods, and describes these procedures as they are practised in France at the present day, giving a concise and well illustrated account of them. A large part of the book is devoted to the older and more classical methods, most of the more recent ones being dealt with by reference only unless they are those of French surgeons, so that, for example, the modern methods of bone-grafting with a mechanical saw, and Putti's methods of arthroplasty, are left undescribed.

The work will be chiefly useful for reference on a few particular methods that have been elaborated by French surgeons.

Minor Surgery. By FREDERICK CHRISTOPHER, M.D., F.A.C.S., Associate in Surgery at Northwestern University Medical School. With a Foreword by ALLEN B. KANAVEL, M.D., F.A.C.S., Professor of Surgery, Northwestern University Medical School. Medium 8vo. Pp. 694, illustrated. 1929. London and Philadelphia : W. B. Saunders Co. 36s. net.

THIS volume is a comprehensive survey of the subject, and covers a field which is important to nearly every practitioner and yet one which is often crowded out of the ordinary course of surgical teaching. The planning of the book on an anatomical basis, with a description of minor ailments as they affect each different part, has tended to redundancy and an unnecessary increase in bulk. As an example, the excellent chapter on furuncles and carbuncles near the beginning of the book renders unnecessary any further description of these conditions in various regions.

Although the limits of 'minor' surgery are indefinable, there are a few surprising omissions and inclusions. In the chapter on the anus and rectum there is no mention of the injection treatment of internal hæmorrhoids, while the 'major' operations of ligature and excision and clamp and cautery are described in detail. Similarly, a careful description of the operation for varicocele would seem to be beyond the scope of this book, while the condition of spermatocele is not mentioned, and the use of trusses in the treatment of hernia is a subject which merits more extensive discussion than it is given in the section on deformities of the trunk.

The chapters on injuries and infections of the upper extremities are excellent. We welcome the description of methods other than Sayre's for treating a fractured clavicle. An account of the technique of using plaster bandages is also an excellent inclusion, and seldom found in any general text-book. The corresponding chapters on the lower extremities are not so good, such conditions as congenital dislocation, pseudocoxalgia, and tuberculous disease being omitted from the discussions on affections of the hip-joint.

The chapter on minor surgical technique and similar descriptions throughout the book are very good, although a section on suture materials would be a welcome addition. The chapter on the 'surgical intern' contains much that is of great value about post-operative care and the complications which may arise during

this period. The remarks about the personal qualities and obligations of an 'intern', although perhaps not appealing to the average British house surgeon, recall strongly the description by John Arderne of the "Qualities required in a Good Surgeon", written six centuries ago.

The printing is good and only a few minor misprints were noted. There are numerous illustrations and photographs, all of which are extremely clear and helpful.

Die Chirurgie. A System of Surgery. Edited by Professors M. KIRSCHNER (Tübingen) and O. NORDMANN (Berlin). Fasc. 25 (Vol. III). Royal 8vo. Pp. 387–608, with 105 illustrations in the text and 8 coloured plates. 1929. Berlin and Vienna: Urban & Schwarzenberg. RM. 15.

THE present number forms part of the third volume of the system, and it deals with the surgery of the brain with its coverings (Professor Egon Ranzi, of Innsbruck) and that of the vegetative nervous system (Professors Brüning and Stahl, of Berlin).

The discussion and description of the chief phases of cerebral symptoms are comparatively brief. Commotio cerebri or concussion is regarded as being due to sudden pressure upon the medullary and basal nuclei, rather than as a diffuse anæmia of the brain as a whole. The sections on gunshot wounds of the brain are more full and detailed than is usual and are illustrated with good coloured figures. In the description of thrombosis of the cavernous sinus, two methods of direct attack upon the seat of disease are mentioned, but the practical value of ligation of the angular vein is omitted. The section on tumours of the brain is very well illustrated, but otherwise it does not call for any special comment. In dealing with the technique of craniotomy, the use of a tourniquet round the head is given prominent mention; local anæsthesia is recommended; and the opening of the skull is to be by wide osteoplastic flaps, cut by motor-driven burrs.

The chapters on the sympathetic nervous system give an excellent summary of this very modern surgical problem. The anatomical drawings are both accurate and beautiful. The histological figures of the stellate ganglion would be of more value if the normal structure were depicted and the points of variation noted.

An Introduction to the Study of the Nervous System. By E. E. HEWER, D.Sc. (Lond.), Lecturer in Histology and Assistant Lecturer in Physiology at the London (Royal Free Hospital) School of Medicine for Women; and B. S. SANDES, Demonstrator in Anatomy at the above School, Surgical Registrar to the London Lock Hospital for Women and Children. Crown 4to. Pp. 104 + xii, illustrated. 1929. London: William Heinemann (Medical Books Ltd.). 21s. net.

PRIMARILY written for students, this book gives, partly in tabular, partly in diagrammatic form, a general survey of the nervous system. This arrangement makes it a useful book of reference for many occasions: for those preparing for the higher examinations in medicine, anatomy, or physiology, and for those who have not the time to look up the many important individual papers to which reference is made in the text.

To the surgeon the most useful section at the moment is that which deals with the autonomic nervous system. At a time when experimental operations upon the sympathetic nerves and ganglia are being somewhat largely practised, surgeons would do well to remind themselves of the extreme complexity of that part of the nervous system into which tentative and not always wise plunges are from time to time made. They will then be prepared for the disappointments which await them.

The book is admirably produced, and the numerous coloured diagrams set forth very clearly the points which they are designed to illustrate.

BOOK NOTICES.

[The Editorial Committee acknowledge with thanks the receipt of the following volumes. A selection will be made from these for review, precedence being given to new books and to those having the greatest interest for our readers.]

The Cancer Process. By J. J. M. SHAW, M.A., M.D., F.R.C.S.E. Medium 8vo. Pp. 16. 1930. Edinburgh: E. & S. Livingstone. 1s. net.

Surgery of the Lung and Pleura. By H. MORRISTON DAVIES, M.A., M.D., M.Ch. (Cantab.), F.R.C.S., Medical Superintendent Vale of Clwyd Sanatorium; Consulting Surgeon to University College Hospital, etc. Demy 8vo. Pp. 355 + xvi, illustrated. Being one of a Monograph series entitled Regional Surgery. General editor, A. P. BERTWISTLE, M.B., Ch.B. (Leeds), F.R.C.S.E. 1930. London: Oxford University Press. 25s. net.

Die Chirurgie der Brustorgane. By FERDINAND SAUERBRUCH. Third edition. Vol. I. Die Erkrankungen der Lungen. Under the direction of H. ALEXANDER, H. CHAOUL, and W. FELIX. Part 2. Die chirurgische Behandlung der Lungentuberkulose. Die parasitären Erkrankungen der Lungen. Lungentumoren. Die chirurgische Behandlung des Asthma bronchiale. Syphilis der Lungen. Imperial 8vo. Pp. 1373 + viii, with 189 illustrations. 1930. Berlin: Julius Springer. RM. 98.

Demonstrations of Physical Signs in Clinical Surgery. By HAMILTON BAILEY, F.R.C.S., Surgeon, Dudley Road Hospital, Birmingham. Second edition, revised and enlarged. Medium 8vo. Pp. 268 + xviii, with 306 illustrations, some of which are in colour. 1930. Bristol: John Wright & Sons Ltd. 21s. net.

A Shorter Surgery. A Practical Manual for Senior Students. By R. J. MCNEILL LOVE, M.B., M.S. (Lond.), F.R.C.S., Assistant Surgeon, Metropolitan Hospital; Hunterian Professor R.C.S. Second edition. Demy 8vo. Pp. 371 + viii, with 74 illustrations, including 31 plates (one coloured). 1930. London: H. K. Lewis & Co. Ltd. 16s. net.

Book of Diets. Bulletin McGuire Clinic St. Luke's Hospital. Second edition, revised. Royal 8vo. Pp. 48. Published quarterly by the staff, 1000 W. Grace Street, Richmond, Va.

Clinique et Thérapeutique chirurgicales. By GEORGE PASCALIS. Pratique Journalière. Medium 8vo. Pp. 290, with 80 illustrations. 1930. Paris: Gaston Doin et Cie. Fr. 50.

La Pratique chirurgicale illustrée. By VICTOR PAUCHET. Fasc. XV. Royal 8vo. Pp. 245, with 200 illustrations by S. Dupret. 1930. Paris: Gaston Doin et Cie. Fr. 65.

Orthopädie im Kindesalter. By Hofrat Prof. Dr. HANS SPITZY (Vienna), with the collaboration of Geh. Hofrat Prof. Dr. FRITZ LANGE (Munich). Third edition, fully revised and enlarged. Crown 4to. Pp. 504 + vi, with 253 illustrations. 1930. Leipzig: F. C. W. Vogel. Paper covers, M. 45; bound, M. 50.

Die Chirurgie. A System of Surgery. Edited by Profs. M. KIRSCHNER (Tübingen) and O. NORDMANN (Berlin). Fasc. 26 (Vol. II). Royal 8vo. Pp. 1583–1828, with 175 illustrations in the text and one coloured chart. 1930. Berlin and Vienna: Urban and Schwarzenberg. RM. 18.

Das Für und Wider der chirurgischen Behandlung des Gallenleidens, auf Grund der Erfahrungen an 800 Gallenoperationen. By Prof. PAUL ZANDER, Chirurg des Elizabethenstifts in Darmstadt. Royal 8vo. Pp. 89, with 8 illustrations. 1930. Leipzig: Georg Thieme. M. 8.50.

The Dramatic in Surgery. By GORDON GORDON-TAYLOR, O.B.E., M.A., F.R.C.S. Surgeon to the Middlesex Hospital. Medium 8vo. Pp. 88. Illustrated. 1930. Bristol: John Wright & Sons Ltd. 12s. 6d. net.

A Textbook on Orthopedic Surgery. By WILLIS C. CAMPBELL, M.D., F.A.C.S., Professor of Orthopedic Surgery, University of Tennessee College of Medicine, etc. Medium 8vo. Pp. 705, with 504 illustrations. 1930. Philadelphia and London: W. B. Saunders Co. 37s 6d. net.

Surgical Diagnosis. By American authors. Edited by EVARTS AMBROSE GRAHAM, A.B., M.D., Bixby Professor of Surgery, School of Medicine, Washington University, St. Louis, etc. 9¼″ × 6″. Vols. I and II. Vol. I. Pp. 919, with 508 illustrations. Vol. II. Pp. 871, with 326 illustrations. To be issued in three volumes and desk index volume. 1930. London and Philadelphia: W. B. Saunders Co. Per set £7 10s. net.

Research and Medical Progress and other Addresses. By J. SHELTON HORSLEY, M.D., Attending Surgeon, St. Elizabeth's Hospital, Richmond, Va. Crown 8vo. Pp. 208, illustrated. 1929. London: Henry Kimpton. 8s. 6d. net.

Diabetic Surgery. By LELAND S. MCMITTRICK, M.D., F.A.C.S., Visiting Surgeon, Palmer Memorial Hospital; and HOWARD F. ROOT, M.D., Assistant Physician, New England Deaconess Hospital. 9½″ × 6″. Pp. 269 + ix, with 79 illustrations in the text and 2 plates. 1929. London: Baillière, Tindall & Cox. 21s. net.

Radium in General Practice. By A. JAMES LARKIN, B.Sc., M.D., D.N.B., Radium Consultant on Staffs of Wesley Memorial, German Evangelical Deaconess, John B. Murphy, Washington Park Community Hospitals, Chicago, etc. Medium 8vo. Pp. 304 + xiii, with 28 illustrations. 1929. New York: Paul B. Hoeber Inc. $6.00

La Rachianesthésie: sa Valeur et sa Place actuelle dans la Pratique. By EMILE FORGUE, Professeur de Clinique chirurgicale à la Faculté de Montpellier; and ANTOINE BASSET, Professeur agrégé à la Faculté de Médecine de Paris, Chirurgien des Hôpitaux. Medium 8vo. Pp. 222, with 23 illustrations. 1930. Paris: Masson et Cie. Fr. 30.

Guy's Hospital Reports. Edited by ARTHUR F. HURST, M.D. January, 1930. Vol. LXXX (Vol. X, Fourth Series). No. 1. Medium 8vo. Pp. 126, illustrated. 1930. London: Lancet Ltd. Annual subscription, £2 2s. net, or 12s. 6d. net per issue.

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